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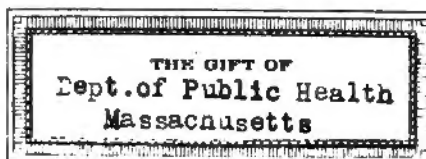
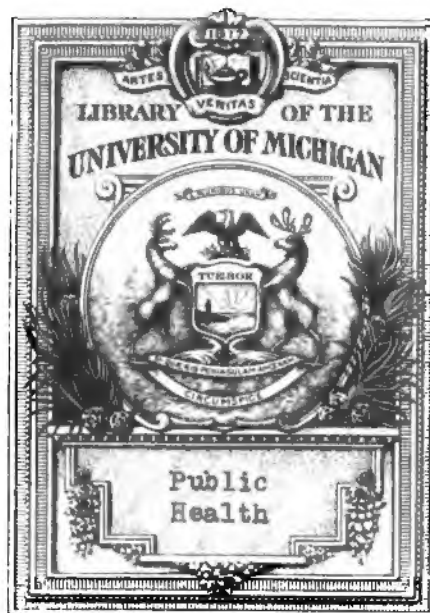
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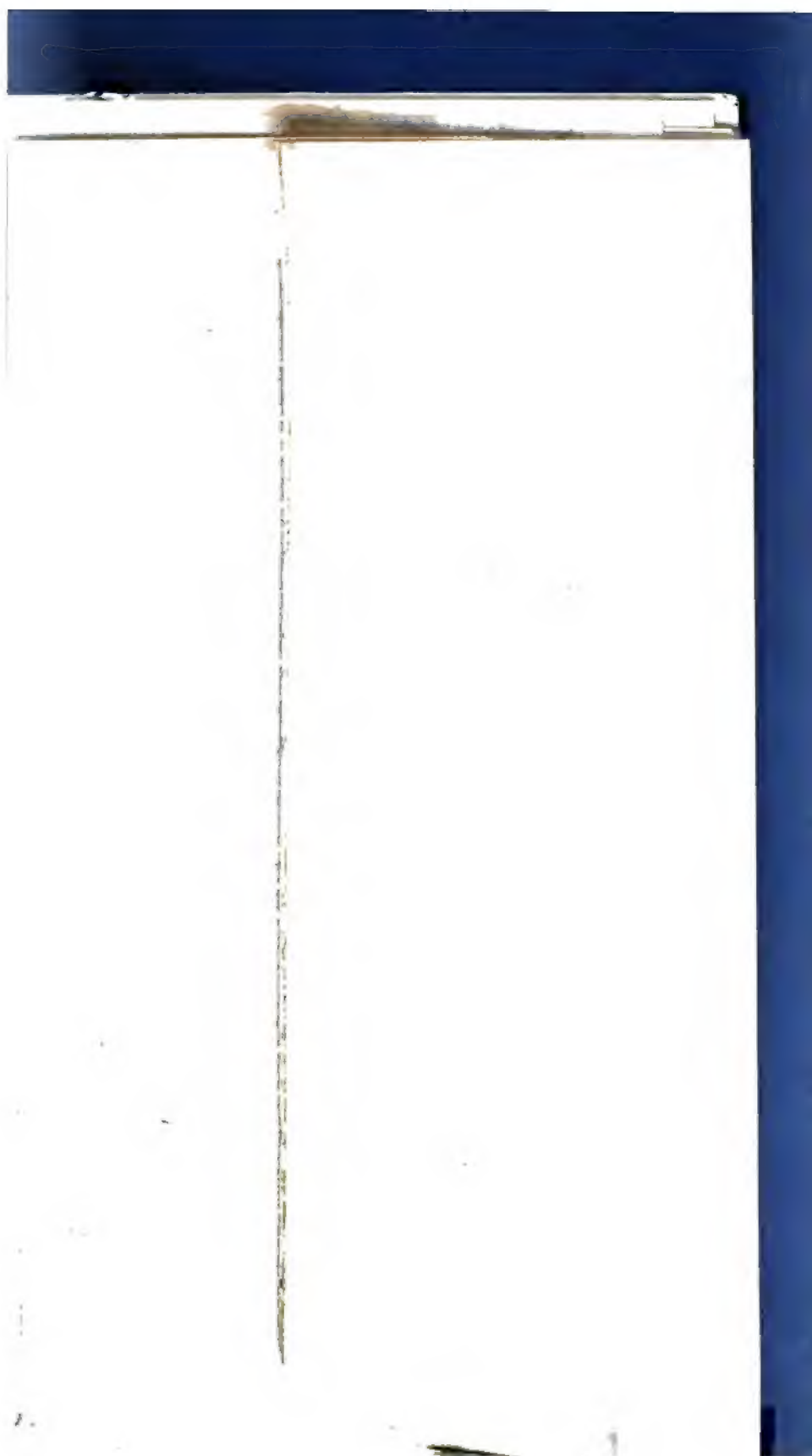
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Disease of the Mind— <i>Con.</i>	Page
VII. Massachusetts Statistics and Asylum Accommodation, .	401
VIII. Supervision by the State,	406
IX. Certain Asylum Needs,	421
X. Medical Education,	426
XI. Summary,	430
7. Health of Towns,—	
Diphtheria in Lynn, by J. G. Pinkham, M. D.,	437
Diphtheria in Salem, by A. H. Johnson, M. D.,	445
Diphtheria in Lowell, by F. Nickerson, M. D.,	451
Replies from Correspondents,	458
Typhoid Fever in South Dennis, by C. M. Hulbert, M. D., . .	495
Table of Death-Rates in 1875,	497

ALPHABETICAL INDEX.

	Page
Access to sewers,	159
Accidents in insane asylums considered,	390
in British asylums,	393
Act of Legislature to amend an Act incorporating the Butchers' Slaughter and Melting Association of Brighton,	3
Acushnet, diphtheria in,	465
Adams, diphtheria in,	465
Administration of Rivers Pollution Act in England,	76
Age-distribution of population of Lynn,	182
Age at which menstruation usually begins in American women,	284
Alcoholism in Lynn,	214
American alienists and their work,	349
leadership in treatment of the insane,	347
principles in treatment of the insane,	350
progress in treatment of the insane,	353
Amherst, diphtheria in,	465
Amusements and occupations for insane patients,	355
Analysis of Merrimac and other waters (<i>Table</i>),	70
of Nashua River waters (<i>Table</i>),	52, 53, 56-58
Andover, diphtheria in,	465
Area and population of Nashua River Basin,	22
Arlington, diphtheria in,	466
Artificial conditions affecting health in Lynn,	184
Ashburnham, diphtheria in,	466
pollution of streams in,	42
Ashby, diphtheria in,	466
pollution of streams in,	42
Asylums for the insane, certain needs of,	421
for the insane, compared with homes,	413
for the insane, number of, in England, January, 1874,	360
Attleborough, diphtheria in,	467
Austria, experience in disposal of sewage,	105
Augusta, Me., sewage-irrigation in,	80

	Page
Average heights and weights of Boston school boys and girls (<i>Tables</i>),	312
heights and weights of Boston school boys and girls of	
American parentage (<i>Table</i>),	297
heights and weights of English boys (<i>Table</i>),	294
Ayer, diphtheria in,	467
pollution of streams in,	42
Bad drainage, effect of, on health,	113
Barking Farm, cost of sewage-irrigation at,	99
Barnstable, diphtheria in,	468
Becket, diphtheria in,	468
Bedford Farm, cost of sewage-irrigation at,	101
Belgium school children, height and weight of (<i>Table</i>),	285
Bellingham, diphtheria in,	468
Berkley, diphtheria in,	468
Berlin, Germany, experience in disposal of sewage,	104
Beverly, diphtheria in,	468
Bichat and Esquirol and the pathology of mental disease,	333
Birth-rate of children of American and foreign parentage in Lynn	
compared (<i>Table</i>),	207
Boards of Health, independent, recommended for cities and towns, .	11
Bolton, pollution of streams in,	43
Boston,—	
Deaths and meteorology of, for 1876,	470
Deaths from various diseases,	470, 471
Health of,	469
Monthly mortality table,	471
School boys and girls, average heights and weights of (<i>Tables</i>), .	312
School children, annual growth and ratio of height to weight	
(<i>Tables</i>),	320
Boylston, pollution of streams in,	43
Braintree, diphtheria in,	474
Branches and junctions of sewers,	160
Brimfield, diphtheria in,	474
Brockton, diphtheria in,	474
Brookline, diphtheria in,	474
Buckland, diphtheria in,	474
Buenos Ayres, yellow fever and filth in,	127
Butchers' Slaughtering and Melting Association, Act to amend Act of	
incorporation of,	3
Catarrh in Lynn,	217
Cerebro-spinal meningitis in Lynn,	217
Certificates of insanity, law for, of State of New York,	427

ALPHABETICAL INDEX.

ix

	Page
Cesspools in Lynn,	192
Cheltenham Farm, cost of sewage-irrigation at,	99
Chemical examination of waters of Nashua River,	48
Chemical processes alone in disposal of sewage, 13 towns (<i>Table</i>),	96
Children, growth of,	12, 275
Circular sent to medical correspondents and others relative to pollution of streams,	22
Circular sent to medical correspondents and clerks of cities and towns relative to the registration of deaths,	233
Climate of Lynn,	176
Clinton, pollution of streams in,	39, 43
Coleridge's views of insanity,	338
Comb manufactories, pollution of streams by,	37
Committal to insane asylums,	406
Communicability of typhoid fever in country towns,	494
Comparative height of boys and girls in Manchester and Stockport, England (<i>Table</i>),	287
Comparative rate of growth of American and German boys (<i>Table</i>),	300
Comparative rate of growth of children of both sexes,	283
Comparative weights of boys and girls in Manchester and Stockport, England (<i>Table</i>),	288
Complaints of discharged patients of insane asylums,	410
Conclusions of English Local Government Board on disposal of sewage,	102
Concord, N. H., sewage-irrigation at,	80
Conolly's work, treatment of the insane,	339
Contagious and infectious diseases,—	
Registration of, in Germany,	267
" in United States,	268
Regulations for, in Holland,	266
Contaminated air and soil as a cause of disease,	116
water as a cause of disease,	114
Contracts, etc., for building sewers,	164
Conway, diphtheria in,	474
Cotton mills, pollution of streams by,	37
Coventry, sewage-precipitation at,	82
Damp cellars in Lynn,	194
Deaths and diseases, registration of,	12, 223
Death-rate of children of American and foreign parentage in Lynn compared (<i>Table</i>),	207
Death-rates in Lynn for 25 years,	202
Death-rate in Lynn by streets (<i>Tables</i>),	223
Deaths per 1,000, in Lynn, at specified ages (<i>Table</i>),	205

	Page
Death-rates for 1876 (<i>Tables</i> of cities and towns),	473, 497
Definitions of insanity,	400
in English Rivers Pollution Act,	79
Dennis, diphtheria in,	474
Depth of sewers,	158
Diarrhœal diseases in Lynn,	210
Diphtheria and croup in Lynn,	212
deposits of night-soil as a factor in,	197
in Massachusetts,—	
Replies from correspondents,	458
Reports from towns (<i>Table</i>),	461
Diphtheria—Special reports by towns,—	
Acushnet, Adams, Amherst,	465
Andover, Arlington, Ashburnham, Ashby, Ashland,	466
Attleborough, Ayer,	467
Barnstable, Becket, Bellingham, Berkley,	468
Beverly,	469
Boston,	470
Braintree, Brimfield, Brockton, Brookline, Buckland, Conway,	
Dennis, East Bridgewater,	474
Eastham, Easthampton, Easton,	475
Enfield, Everett, Fairhaven, Fall River, Fitchburg,	476
Foxborough, Framingham, Granby, Halifax, Hanover,	478
Hanson, Haverhill, Harwich,	479
Holliston, Hingham, Holyoke, Hudson, Huntington,	480
Hyde Park, Kingston,	481
Lancaster, Lawrence,	482
Leominster,	483
Lowell,	451
Lynn,	437
Malden, Manchester, Marblehead, Marlborough,	484
Medfield,	484
Nantucket, Natick, New Bedford, Newburyport, North Andover,	485
Northfield, Pepperell, Pittsfield,	486
Plympton, Princeton,	487
Randolph, Reading, Rockland, Rockport,	488
Salem,	445
Salisbury, Saugus, Sherborn, Shrewsbury, Somerville, Springfield,	489
Stoneham, Sturbridge, Upton, Uxbridge, Wales,	490
Waltham, Ware, Warren,	491
Watertown, Webster, West Boylston, Weymouth, Williamstown,	492
Winchenden, Winchester, Woburn,	493
Worcester, Yarmouthport,	494

ALPHABETICAL INDEX.

xi

	Page
Disease of the mind,	13, 327
Disposal of sewage,	80
in Nashua River Basin,	64
Dix, Miss, her work in establishing insane asylums,	347
Double system of sewers,	159
Drainage of factories in Lynn,	194
Dry refuse, disposal of, in Lynn,	198
Dry-removal of sewage, cost of, in Manchester and Rochdale,	101
Dunstable, pollution of streams in,	43
Durand-Claye on sewage-irrigation,	110
Dwellings, construction, management, site, etc., in Lynn,	198
Dysentery and fever from filth,	128
Dyspepsia in Lynn,	218
Earth-closets, experience with,	129
East Bridgewater, diphtheria in,	474
Eastham, diphtheria in,	475
Easton, diphtheria in,	475
Effect of race on size and growth of children,	291
Enfield, diphtheria in,	276
Engineer for the State recommended,	7
England, treatment of insane in early part of present century,	337
English government statistics of disposal of sewage,	90
English insane asylums described,—	
Tue Brook Villa,	376
Rainhill,	373-376
West Riding Asylum,	377
English progress in the treatment of the insane and Conolly,	337
Enteric fever at Lausen from polluted water,	124
Erysipelas in Lynn,	214
Escapes from insane asylums,	394
Esquirol and advances in knowledge of insanity,	333
Everett, diphtheria in,	476
Examination of insane by experts,	359
Expenses of the Board,	17
Experiments with sewage-irrigation in Massachusetts,	80
Fairhaven, diphtheria in,	476
Fall River, diphtheria in,	476
Farming, percolation in,—	
Effect of, and experiments,	71
Fatal accidents in insane asylums,	391
Faults in Massachusetts registration law,	261
Fever from watered (?) milk,	122

	Page
Filth not safe,	118
Filtration of sewage,	91
Filtration and precipitation of sewage,	97
Fitchburg, diphtheria in,	476
pollution of streams in,	43
Flooding of cellars from sewers,	150
Flushing of sewers,	147, 161
Fordham, case of,	398
Foreigners, death-rates of, in Lynn,	208
Forms of sewers,	155
Foxborough, diphtheria in,	478
Framingham, diphtheria in,	478
France, experience in disposal of sewage,	105
Fresh waters or lakes of Lynn,	172
Garbage, removal of, in Lynn,	197
Gas works, pollutions of streams by,	38
Germany, experience in disposal of sewage,	104
present condition in, of study of mental disease,	336
progress in study of mental disease,	335
Gheel,	328, 334, 430
Granby, diphtheria in,	478
Griesinger and mental disease,	336
Groton, pollution of streams in,	44
Growth of children,	12, 275
of children (<i>Tables</i>),	312, <i>et seq.</i>
Halifax, diphtheria in,	478
Hanover, diphtheria in,	478
Hanson, diphtheria in,	479
Harvard, pollution of streams in,	44
Harwich, diphtheria in,	479
Haverhill, diphtheria in,	479
Health districts in Lynn,	220
Health of different districts and streets in Lynn,	217
Health of towns,	14, 437
Height and weight of Belgian school children (<i>Table</i>),	285
Hille's process of disposal of sewage,	85
Hingham, diphtheria in,	480
History of registration,	258
Holland, regulations for contagious and infectious diseases,	266
Holliston, diphtheria in,	480
Holyoke, diphtheria in,	480

ALPHABETICAL INDEX.

xiii

	Page
House drainage,	160
in Lynn,	192
regulations for, in Frankfort-on-the-Main,	130
House drains, plans of disconnection of, with sewers described,	331
Hudson, diphtheria in,	480
Humidity (relative) of air of Lynn,	179
Huntington, diphtheria in,	480
Hyde Park, diphtheria in,	481
Inclination of sewers,	153
Independent boards of health for cities and towns,	11
Influenza in Lynn,	214
Insane (The),—	
Admissions of, to asylums, and number of acute cases in Massa-	
chusetts, 1832-75 (<i>Table</i>),	402
American principles in treatment of,	350
American progress in the treatment of,	341
in Massachusetts, 1853 and 1875,	403
benefit of removal of restraint, and occupation for,	384
Committal of, to asylums,	406
Conolly's work in treatment of,	339
Curability considered, 335, 360, 369, 383, 403, 427	
Early treatment of,	327
Early treatment of, in Christian and Mohammedan countries,	329
Examination of, by experts,	359
General treatment of, last quarter past century,	331
Improper committals of, to asylums,	407
Individual treatment of,	360
Massachusetts statistics of, and asylum accommodations,	401
Number of, in Massachusetts, and ratio to population in census	
years, 1820-75 (<i>Table</i>),	402
Number of, in Scotland,	361
Period of American leadership in treatment of,	349
Progressive increase of, in Massachusetts,	401
Project of a law relative to,	414
Ratio of curable cases in asylums growing less,	403
Treatment of, by ancient Egyptians and Greeks,	327
By the Monks,	329
During the last century, and opinions of the age,	330
Insane Asylums,—	
Complaints of discharged patients,	410
Dix, Miss, her efforts in establishing,	347
First known,	328

	Page
Insane Asylums—<i>Con.</i>	
First in England,	330
Germany,	334
United States,	341
Inadequate accommodation in, generally in United States, . .	405
Increased accommodation in, necessary in Massachusetts, . .	404
In England and America, close of last century,	330
Life in, picture of, at Somerville, in 1839,	348
Insanity, advances in ideas and treatment of—	
American leaders, after Rush and Wyman,	349
Bard, Dr., in New York,	342
Bell, Dr.,	347, 349–352, 383, 384, 424, 431
Bichat,	333, 334, 431
Bond, Dr., in Philadelphia,	340, 341
Browne, Dr. J. C.,	377, 379, 424
Chapin, Dr.,	353, 354, 425
Conolly,	337, 339–341, 390
Conrad, Dr.,	346, 384
Cullen,	330, 333
Dix, Miss,	347, 348
Earle, Dr.,	329, 343, 349, 353, 355, 426
Esquirol,	333, 334, 430
Gray, Dr.,	354, 426
Greding,	333
Griesinger,	335, 336, 341, 389
Guislain,	389, 390
Heinroth,	335
Hill, R. Gardiner,	340
Howe, Samuel G.,	349, 406
Hunter, John,	330, 431
Ideler,	336
Jacobi,	335
Jarvis, Dr. Edward,	327, 347, 349, 403, 431
Kirkbride, Dr.,	349, 350, 355, 424, 431, 433
Langermann,	335
Mann, Horace,	346
Maudsley,	397, 400, 414, 424
Meyer,	341
Meynert,	336, 414
Morel,	341
Pienitz,	335
Pinel,	331, 332, 333, 422, 430
Ray,	342, 348, 350, 351, 353, 397, 431

ALPHABETICAL INDEX.

xv

Page

Insanity, advances in ideas and treatment of—*Con.*

Rush,	331, 341, 342, 431
Shew, Dr.,	385
Steuart, Dr. R. S.,	343, 425
St. Vincent de Paul,	329, 430, 431
Tuke, William,	337
Van der Kolk,	335
Virchow,	336, 431
Walker, Dr. C. A.,	411
Westphal,	336
Willis,	330

Insanity, certificates of, law in State of New York,	427
Coleridge's views of,	338
Definitions of,	327, 331, 335, 349, 350, 397, 399, 400, 401

Insanity, early ideas in regard to,—

of the Egyptians,	327, 328
of the Greeks and Romans,	327, 328
of the Hebrews,	331
of Hippocrates and his disciples,	328, 331
of Plato,	328

Insanity, letters and opinions on,—

Bucknill, Dr. J. C.,	361, 392, 396, 400, 417-421
Clouston, Dr. T. S.,	368-371, 411, 412
Coxe, Sir James,	371, 373, 414
Fraser, Dr. John,	362-368
Lindsay, Dr. W. Lander,	359
McDonald, Dr. C. F.,	406
McFarland, Dr. A.,	382, 405
Owen, Dr. Harold,	376, 377
Ranney, Dr. Mark,	405
Reynolds, Dr. A.,	406
Rogers, Dr. T. L.,	373-376
Stearns, Dr. H. P.,	381, 382
Tuke, Dr. J. Batty,	362, 400
Westphal, Prof. Charles,	379, 380
Wilkes, James,	392, 400

Intelligence in population of Lynn,	183
---	-----

Intemperance and immorality in Lynn,	201
--	-----

Intermittent downward filtration of sewage (<i>Table</i>),	95
--	----

Irrigation by sewage,—

at Augusta, Me.,	80
at Concord, N. H.,	80
Cost of, at Barking Farm,	99

	Page
Irrigation by sewage— <i>Con.</i>	
at Bedford Farm,	101
at Cheltenham Farm,	99
Experiments in Massachusetts,	80
Results of, in England,	92
Some objections to,	112
 Kingston, diphtheria in,	 481
Kullmann, case of,	398
 Lancaster, diphtheria in,	 482
pollution of streams in,	44
Law concerning slaughter-houses and noxious and offensive trades,—	
Petitions under, from towns,	5
Lawrence, diphtheria in,	482
Leather-board mills, pollution of streams from,	38
Legislation to prevent pollution of streams,—	
in England,	73
Propriety of, in Massachusetts,	65
Leominster, diphtheria in,	483
pollution of streams in,	44
Liernur system for disposal of sewage,	82
Linen mills, pollution of streams by,	38
Lowell, diphtheria in,—	
Age, sex and race,	453
Foci of the disease,	454
Locality,	453
Localities where prevalent described,	456
Nature of the disease,	453
Prevalence of,	452
Lowell, examination of well-water in (<i>Table</i>),	455
Mortality of, from typhoid fever, small-pox and diphtheria, 1846,	
1871, 1876,	452
Lunenburg, pollution of streams in,	44
Lynn, diphtheria in,—	
Artificial conditions under which the disease prevailed,	442
Contagiousness of the disease,	443
Methods of investigation,	437
Natural conditions under which the disease prevailed,	438
Summary of investigations,	444
Lynn, sanitary condition of,	11, 171
Annual death-rate of, for 25 years, 1851-75 (<i>Table</i>),	202
Artificial conditions affecting health in,	184

ALPHABETICAL INDEX.

xvii

Page

Lynn, sanitary condition of—*Con.*

Birth-rate of children of American and foreign parentage compared,	207
Causes of increased death-rate of children of foreign parentage,	208
Climate,	176
Damp cellars,	194
Deaths per 1,000 at specified ages (<i>Table</i>),	205
Death-rate of children of American and foreign parentage compared (<i>Table</i>),	207
Death-rate by streets (<i>Tables</i>),	223
Diseases prevalent,	209, 226
Drainage of factories,	194
Dry refuse,	198
Dwellings,	198
Fresh waters or lakes,	172
Garbage,	197
Health of different districts and streets,	218
Health districts,	220
Humidity (relative) of air,	179
Intemperance and immorality,	201
Mortality of children of natives and foreigners compared,	206
Mortality at different ages (<i>Table</i>),	205
Mortality of sexes compared,	208
Natural conditions affecting health,	171
Natural drainage,	174
Night-soil,—	
As a factor in diphtheria,	197
Disposal of,	195
Normal death-rate,	208
Percentage of births to deaths of children under one year of age for 10 years,	206
Piggeries,	198
Population,—	
Age distribution,	182
Intelligence,	183
Nationality,	181
Pauperism,	184
Occupation,	183
Rate of increase,	180
Sources of increase,	181
The sexes,	183
Wealth,	183
Prevailing diseases,	209

	Page
Lynn, population— <i>Con.</i>	
Prevailing winds,	178
Pulmonary consumption,	215
Rainfall,	178
Rocks,	173
Sanitary needs of the city,	227
Sewerage of the city,—	
Benefits of,	190
Defects in,	191
Cesspools,	192
House drainage,	192
Surface and under drainage,	193
Traps,	193
Shoe-shops,	199
Situation,	171
Soil and subsoil,	173
Temperature,	177
Topography,	171
Water-supply,—	
Character of well-water,	188
Character of pond-water,	189
Sources of supply,	184
Weather,	178
Wells,—	
Bad and contaminated,	184
Illustrations of,	186
Malaria in Lynn,	214
Malden, diphtheria in,	484
Management and curability of insane,	384
Manchester, diphtheria in,	484
Main outfall sewers,	145
Maps of localities to be sewered,	144
Marblehead, diphtheria in,	484
Marlborough, diphtheria in,	484
Massachusetts registration law,	259
Mathematical formulas to express relation between height and weight of children,	310
Material of sewers,	155
McLean Insane Asylum, establishment and workings of,	344
Measles in Lynn,	214
Medfield, diphtheria in,	484

ALPHABETICAL INDEX.

xix

Page

Mental disease,—

Discoveries in pathology of, by Bichat and Esquirol,	333
Four great epochs in treatment of,	430
Importance of knowledge of, to physicians,	427, 432
Liability shared by all,	433
Neglect of study in medical schools,	426
Progress of the century in knowledge of,	430
Mental hygiene, Dr. Ray's treatise,	353
Menstruation in American women, age at which it usually begins (Table),	284
Merrimac River, pollution of,	68
Method of investigation in growth of children,	277
Metric system (Table),	16
Milk, contaminated, a source of disease,	122
Mind, disease of the,	13, 327
Modern methods of less restraint of insane,	358
Moral treatment of the insane,	330, 350-352
Mortality at different ages in Lynn (Table),	205
of children of natives and foreigners in Lynn compared,	206
of eleven cities of Massachusetts for ten years (Table),	204
of the sexes of Lynn compared (Table),	208
of towns and cities of Massachusetts, alphabetically arranged,	297
Nantucket, diphtheria in,	485
Nashua River, pollution of,	61
Pollution of, beyond state line,	67
Basin, area and population of,	22
Natick, diphtheria in,	485
Nationality in population of Lynn,	181
Natural conditions affecting health in Lynn,	171
drainage of Lynn,	174
water-courses in their relations to sewers,	144
Necessity of the registration of deaths and disease,	264
for sewerage, proper methods, etc.,	139
New Bedford, diphtheria in,	485
Newburyport, diphtheria in,	485
Night-soil, disposal of, in Lynn,	195
Normal death-rate of Lynn,	208
No-removal of sewage, cost of,	102
North Andover, diphtheria in,	485
Northfield, diphtheria in,	486

	Page
Observations of Baxter, Boudin, Cowell, Gould, Quetelet and Vil-	
lermé on growth of children,	292
Occupation of population of Lynn,	183
Opinions of experts on disposal of sewage,	88
Overflow of sewage on land,	90
Oxidation of sewage,	117
 Paper mills, pollution of streams by,	 37
Paris,—	
Disposal of sewage,	106
Illustration of the benefit of registration of disease,	265
Intercepting sewer and deep-sea outlet for,	107
Irrigation by sewage,—	
Letter on, by M. Alfred Durand-Claye,	110
Objections to, below the city,	105
Present condition, etc.,	108
Precipitation of sewage,	107
Pathologists for insane asylums,	354
Pauperism in Lynn,	184
Pepperell, diphtheria in,	486
Percentage of births to deaths in Lynn of children under one year of	
age for 10 years (<i>Table</i>),	206
Piggeries in Lynn,	198
Pinel and non-restraint of the insane,	332
Pinel's knowledge of insanity,	333
reform and European progress,	332
Pittsfield, diphtheria in,	486
Plympton, diphtheria in,	487
Points for the consideration of collectors of vital statistics,	308
Pollution of the Nashua,	61
of the Nashua beyond state line,	67
Polluted water, effect of, on health,	122
Pond-water, character of, in Lynn,	189
Population of Lynn,	180
of towns in Nashua River Basin (<i>Table</i>),	23
Practical application of the laws of the growth of children,	308
Precipitation of sewage,	95
Preliminary study for sewerage,	143
Present and future wants in sewerage,	146
condition of some of our worst insane asylums,	357
methods of disposal of sewage in Leeds,	84
Prevailing diseases of Lynn,	209
winds of Lynn,	178

ALPHABETICAL INDEX.

xxi

	Page
Prevention of filth diseases,	129
Princeton, diphtheria in,	487
pollution of streams in,	44
Progress in disposal of sewage in Glasgow,	81
Pulmonary consumption in Lynn,	215
Purification of polluted streams,	59
Purist (the), theory of contaminated water,	115
Purpura in Lynn,	215
Quetelet's observations on the growth of children,	286, 293
Rainfall in Lynn,	178
Randolph, diphtheria in,	488
Rate of increase in population of Lynn,	180
Rates of mortality in Lynn,	202
Ray, Dr. Isaac, and treatment of the insane,	348
Reading, diphtheria in,	488
Records of sewers,	166
Registration of deaths and diseases,	12, 223
of disease and British Medical Association,	265
of contagious and infectious diseases,	267, 268
illustrations of benefits from,	265
of prevalent diseases in Massachusetts and Michigan,	269
Regulations for contagious and infectious diseases in Holland,	266
Relation of height to weight in children,	303
Replies from medical correspondents on registration of deaths,	235
from clerks of cities and towns on registration of deaths,	260
Report to Amer. Soc. Sc. Association, in 1872, on growth of children,	275
Reported causes of death in Massachusetts,	262
Responsibility for crime in the insane,—	
Lord Hale's principle,	397
Most advanced positions,	398, 399
Recent English decision,	398
Recommendations of English Lunacy Commission,	399
Restraint in the treatment of the insane,	382-394
Methods considered,	382
Position of English and European experts on,	386
Griesinger,	389
Guislain,	389
Meynert,	389
Sheppard, Dr. Edgar,	389
Sutherland, Dr.,	386
Superintendents in England,	389
Westphal, Prof.,	380

	Page
Restraint in the treatment of the insane— <i>Con.</i>	
Wilkes, Mr. James,	388
Yellowlees, Dr.,	387, 388
Retreat for insane at Hartford,	345
Rheumatism in Lynn,	214
Rivers Pollution Act of England,—	
Administration of,	76
Definitions,	79
Legal proceedings under,	77
Manufacturing and mining pollutions,	75
Saving clauses,	78
Sewage pollutions,	74
Solid matters,	74
River statistics, Nashua River Basin (<i>Tables</i>),	25
Remarks on,	32
Summary of,	34
Rockland, diphtheria in,	488
Rockport, diphtheria in,	488
Rush, Dr., on responsibility of cities for conditions of disease,	136
Salem, diphtheria in,—	
Influences favorable to,	450
Localities where prevalent,	446
Map showing sections of city visited by diphtheria,	447
Number of cases and distribution of,	445
Salisbury, diphtheria in,	489
Sanitary needs of Lynn,	227
Saugus, diphtheria in,	489
Saw mills, pollution of streams by,	38
Scarlatina in Lynn,	212
Sewage-clarification at Walpole,	65
irrigation, objections considered,	112
precipitates generally,	87
precipitation,	95
Sewerage districts,	146
its advantages, disadvantages, etc.,	11, 139
of Lynn,—	
Preliminary study for,	143
Present and future wants in,	146
Sewer-gas, composition of,	121
Sewers,—	
Access to,	159
Branches and junctions,	160

ALPHABETICAL INDEX.

xxiii

Page

Sewers—*Con.*

Contracts for, etc.,	164
Depth of,	158
Disadvantages of, considered,	166
Double system of,	159
Existing,	145
Flooding of cellars from,	150
Flushing of,	147, 161
Forms of,	155
Inclination of,	153
Main outfall,	145
Material of,	155
Natural water-courses in relation to,	144
Records of,	166
Sizes of,	151
Soil-water in relation to,	150
Storm-water, in relation to,	149
Supply of water to,	161
Thickness of,	157
Ventilation of,	163
What should be admitted into,	149
Sexes, the, in population of Lynn,	183
Sherborn, diphtheria in,	489
Shirley, pollution of streams in,	44
Shoddy mills, pollution of streams by,	38
Shoe shops in Lynn,	199
Shrewsbury, diphtheria in,	489
Situation of Lynn,	171
Slaughter-houses and noxious and offensive trades,—	
In Miller's River district,	4
Petitions under law for, from towns,	5
Regulations for, and inspection recommended,	4
Small-pox in Lynn,	214
Soil and subsoil of Lynn,	173
Somerville, diphtheria in,	489
Sources of disease from polluted water,	114
Sources of increase of population of Lynn,	181
Specific-poison theory of disease, and illustration of,	118
Springfield, diphtheria in,	489
State insane asylums in United States,	346
Sterling, pollution of streams in,	45
Stoneham, diphtheria in,	490
Sturbridge, diphtheria in,	490

	Page
Substitutes for restraint of insane,	390
Subsidence and filtration of sewage,	92
simple, of sewage,	91
Summary of restraint (of insane) question,	394
Summary of survey of Nashua River Basin,	46
Supervision of insane in England, letter of Dr. Bucknill,	417
Supervision of insane asylums,—	
By the State,	406
False position of American Association of Superintendents, .	409
More and better, needed,	408
Uses of state commission,	408
Visitation by friends one of the best,	411
Surface and under drainage of Lynn,	193
Survey of Nashua River basin,	38
Surveys for sewerage,	143
Syphilis in Lynn,	214
Tanneries, pollution of streams by,	37
Temperature in Lynn,	177
Thickness of sewers,	157
Topography of Lynn,	171
Towns, health of,	14, 437
Townsend, pollution of streams in,	46
Treatment of the insane, opinions and letters,—	
Dr. Bucknill,	361
Dr. Clouston,	368
Dr. McFarland,	382
Dr. Owen,	376
Dr. Rogers,	373
Dr. Stearns,	381
Dr. Tuke and Dr. Fraser,	362
Prof. Westphal,	379
Sir James Coxe,	371
Typhoid fever, communicability of, in country towns,	494
in Lynn,	210
Upton, diphtheria in,	490
Uxbridge, diphtheria in,	490
Ventilation of sewers,	163
Vital statistics, points for consideration of collectors,	308
Wales, diphtheria in,	490
Waltham, diphtheria in,	491

ALPHABETICAL INDEX.

xxv

	Page
Ware, diphtheria in,	491
Warren, diphtheria in,	491
Water-supply, source of, in Lynn,	184
Watertown, diphtheria in,	492
Wealth of population of Lynn,	183
Weather in Lynn,	178
Webster, diphtheria in,	492
Wells, illustrations of several bad and contaminated, in Lynn,	186
Well-water, character of, in Lynn,	188
West Boylston, diphtheria in,	492
pollution of streams in,	46
Westminster, pollution of streams in,	46
Weymouth, diphtheria in,	492
What should be admitted into sewers,	149
Whitthread process of disposal of sewage,	85
Whooping-cough in Lynn,	213
Willard Insane Asylum, New York, described,	353
Williamstown, diphtheria in,	492
Winchendon, diphtheria in,	493
Winchester, diphtheria in,	493
Woburn, diphtheria in,	494
Woollen mills, pollution of streams by,	35
Worcester, diphtheria in,	494
insane asylum in 1848,	353
Yarmouthport, diphtheria in,	494
Yellow fever and filth, city of Buenos Ayres,	127

Commonwealth of Massachusetts.

STATE BOARD OF HEALTH, STATE HOUSE, }
January 24, 1877. }

Hon. J. B. D. COGSWELL, *President of the Senate of Massachusetts.*

SIR:—I have the honor to present to the Legislature the **Eighth Annual Report of the State Board of Health, including the Special Report on the Pollution of Streams, Disposal of Sewage, etc.**

Very respectfully,
Your obedient servant,

CHARLES F. FOLSOM, M. D.,
Secretary of the State Board of Health.

Commonwealth of Massachusetts.

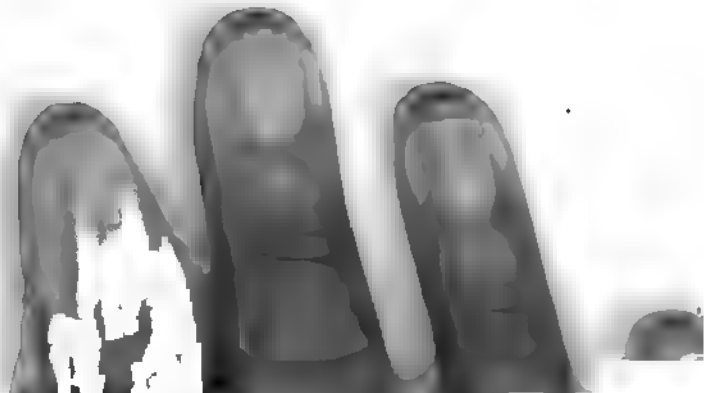
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GENERAL REPORT OF THE BOARD.

STATE BOARD OF HEALTH, STATE HOUSE, }
January 20, 1877. }

*To the Honorable the Senate and the House of Representatives of
Massachusetts.*

The State Board of Health herewith present their Eighth
Annual Report:—

THE LAW CONCERNING SLAUGHTER-HOUSES AND NOXIOUS AND OFFENSIVE TRADES.

At their own request, and by the provisions of the following Act, chapter 144 of the Acts of the General Court of Massachusetts, 1876, the Board have been relieved of all farther care of the abattoir at Brighton, and they take pleasure in testifying to the satisfactory condition of that establishment:—

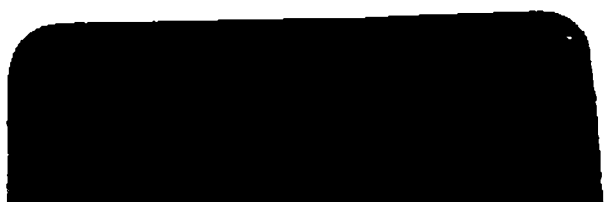
AN ACT to amend an Act to incorporate the Butchers' Slaughtering and Melting Association, in Brighton.

Be it enacted, etc., as follows:

SECTION. 1. Section six of chapter three hundred and sixty-five of the acts of the year eighteen hundred and seventy, is hereby repealed; and sections two and four of said act are hereby amended, by striking out the words "state board of health" where they occur in said sections, and substituting in place thereof, "board of health of the city of Boston."

SECT. 2. From and after the first day of June, eighteen hundred and seventy-six, the business of slaughtering shall not be conducted within the limits of the city of Boston, except upon the premises of the Butchers' Slaughtering and Melting Association, in said city.

SECT. 3. The said association shall, within a reasonable time, slaughter all cattle, sheep and calves which may be brought to their



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STATE BOARD OF HEALTH, STATE HOUSE, }
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engineer of some gentleman of skill and experience, to be paid by the parties who consult him.

"There should be absolute prohibition in all cases against casting sewage or filth of any kind into any stream or pond used as a source of water-supply. Where such conditions now exist, the sewage or filth should be diverted to some other channel. For, until our knowledge has so far advanced as to enable us to recognize 'germs' of disease, and to destroy them effectually by some simple and easy process, even purified sewage must always be looked upon as a dangerous addition to drinking-water. .

"The following are the recommendations which the Board respectfully offer in their summary :—

"1. That no city or town shall be allowed to discharge sewage into any water-course or pond without first purifying it according to the best process at present known, and which consists in irrigation; provided, that this regulation do not apply to the discharge from sewers already built, unless water-supplies be thereby polluted; and provided, also, that such intended discharge can be shown to be at such point or points that no nuisance will arise from it.

"2. That no sewage of any kind, whether purified or not, be allowed to enter any pond or stream used for domestic purposes.

"3. That each water-basin should be regarded by itself in the preparation of all plans of sewerage and water-supply.

"4. That accurate topographical surveys be always made of all towns before introducing water-supplies or sewers.

"5. That steps should be taken, by special legislation based upon investigations and recommendations of experts, to meet cases of serious annoyance arising from defective arrangements for the disposal of sewage.

"6. That irrigation be adopted, at first experimentally, in those places where some process of purification of sewage is necessary; and that cities be authorized by law to take such lands as may be necessary for that purpose.

"7. That every town or city of over four thousand inhabitants be required by law to appoint a board of health, the members of which shall not be allowed to hold any other offices in the government of their city or town.

"Finally: The Board feel, that, in the present state of our knowledge, sweeping laws for the general and immediate purification of all our streams would be hardly justifiable, and that they are not called for by the present condition of our rivers."

Section 1 of these recommendations we would so modify, that the last sentence will read, "and provided, also, that such intended discharge can be shown to be at such point or points, *or with such complete or partial purification* that no nuisance will arise from it."

When the last report was sent to the Legislature, the Board did not feel prepared to make any recommendations with regard to manufacturers; we therefore desire to add the following section:—

That no manufactories hereafter established for carrying on trades, from which there is any refuse matter, be allowed to discharge polluting substances into any stream or pond used as a source of domestic water-supply; that they be forbidden to discharge any solid substance (not including matters in suspension) into any streams or ponds of the Commonwealth, and that they be required to purify or cleanse, according to the best available means, all polluting substances discharged by them into streams or ponds;—provided they are not able to satisfy a proper authority that any such solid or polluting substances will work no practical harm to the public.

In connection with this Report, the Secretary has prepared a statement of the advance in knowledge and experience on this subject during the year, in this country and in Europe; and a valuable paper is contributed by E. S. Chesbrough, C. E., on sewers and sewerage.

The experience of other countries has not thus far shown that sewage can be disposed of on a large scale either by irrigation, precipitation, or dry removal, in such a way as to be satisfactory from a sanitary point of view, and at the same time be profitable.

Complete and speedy removal, or thorough disinfection by sufficient quantities of earth or by other means, are, however, essential to health. To attain this purpose, in the opinion of the Board, no method at present known is so satisfactory as abundant and pure water-supplies, with well-devised and skil-

fully constructed sewers, carrying the sewage to a safe distance. Of course, this is not always practicable.

In the equally important matter of the proper construction of internal and external house arrangements, the Board cannot do better than recommend to local authorities the rules which have been carried out successfully for several years at Frankfort-on-the-Main, described on a later page of this Report.

Personal hygiene must, it is true, supplement laws protecting the public health; but without such laws, in many cases, no care on the part of individuals can save them from fatal diseases. Very few States, unfortunately, if indeed any, fully recognize their responsibility in this matter, and we are still very far from knowing all the causes of even all the "preventable" diseases, although we have become familiar with some few of them and with many of the circumstances without which others do not often occur. We do know enough, however, to justify us in repeating the prediction of one of the most distinguished men our country has produced, Dr. Benjamin Rush, who said at the beginning of our history as a nation that *the means of preventing pestilential fevers "are as much under the power of human reason and industry as preventing the evils of lightning and common fire. I am so satisfied of the truth of this opinion, that I look for a time when our courts of law shall punish cities and villages for permitting any of the sources of billious and malignant fevers to exist within their jurisdiction."*

OTHER INVESTIGATIONS DURING THE YEAR.

It was found, at a late day, that four of the papers intended for publication would require to be deferred, in order to allow more time for their completion. This is the only apology which the Secretary has to offer for occupying so large a portion of the report.

The following special papers, prepared during the year, are respectfully submitted to the Legislature for their consideration :—

SEWERAGE :—ITS ADVANTAGES AND DISADVANTAGES, CONSTRUCTION AND MAINTENANCE.

By E. S. CHESBROUGH, C. E., City Engineer of Chicago.

The importance of sanitary engineering has been only recently recognized in this country, and it is just beginning to command the attention which it deserves. The Board have been able to place before the community a paper on the above subject, by one of the first and most experienced sanitary engineers, and they hope that its practical suggestions and forcible reasoning will receive that attention to which they are entitled. The connection between good sewerage and good health, although often exaggerated, is shown to be direct and immediate, and to be one of the many ways in which satisfactory sanitation is to be got in populous places. At the same time, the writer wisely cautions the public from expecting too much from a single measure, where the causes of ill health are so manifold and so complex as must always be the case in all large cities.

THE SANITARY CONDITION OF LYNN.

By J. G. PINKHAM, M. D., Correspondent of the Board for the city of Lynn.

The Board take pleasure in presenting to the Legislature the sanitary survey of Lynn. They hope that much good will result therefrom, not only to Lynn, but to all other cities in the State. Such a survey ought to be made of every town in the Commonwealth. If it were done, and efficient and wise action taken thereupon, an immense amount of preventable disease might be avoided.

To the inhabitants of Lynn, this report ought to speak in terms not to be misunderstood. The Board hope that Dr. Pinkham's remarks on the necessity of having an independent board of health, will be listened to and a plan adopted forthwith. Such a board should be wholly removed from the domain of politics, have ample power, and hold office for several years.

The Board would urge this as a general recommendation to the Legislature and to the cities and towns of the State.

REGISTRATION OF DEATHS AND OF DISEASES.

By CHARLES F. FOLSOM, M. D., Secretary of the Board.

In 1842, the registration of vital statistics was commenced in Massachusetts, and, ever since, the registration reports have been edited by able and excellent men upon the returns sent in from the various cities and towns of the Commonwealth. The Board sincerely regret to find that the imperfect manner in which the vast majority of these returns have been made,—as they will continue to be made unless some more stringent laws can produce a radical change,—seriously impairs their value.

The Legislature have only to read the returns from our correspondents, and from the clerks of the cities and towns in the State, to feel convinced of the truth of this assertion. It seems evident that physicians, clerks of towns, undertakers, and sextons, should be compelled, under sufficient penalties, to do their respective duties. The community itself should also decide that, under no circumstances, should any body be buried until after proper legal formalities.

Finally, the registration should be put under the direction of experts who would have an interest in the matter, and one of whose duties it should be to see that, as far as possible, the registration-laws are obeyed.

In the important matter of the registration of diseases, much useful information is brought to the attention of the Legislature and of local authorities. It undoubtedly underlies one of the most fundamental principles of prevention of disease, and has already been adopted to some extent in some of the cities of Europe, in Brooklyn, N. Y., and in Pittsburg, Penn.,—nowhere, however, so efficiently and with such good results as in Holland. It is to be hoped that measures may be taken to render it possible here.

THE GROWTH OF CHILDREN.

By HENRY P. BOWDITCH, M. D., Professor of Physiology in Harvard University.

This article embodies the results of measurements of the height and weight of about 24,500 school children of the city of Boston. The observations are in part distributed accord-

ing to the nationality of the parents, and conclusions are drawn as to the comparative rates of growth of the two sexes and of children of different races. It is hoped that this investigation may be the means of calling the attention of those having charge of children to the importance of collecting vital statistics of this sort. Physical education is now recognized as of not less importance than mental training in all our public schools, but no means have been provided for ascertaining how far the training of the body is successful in improving the physique. Annual examinations determine with tolerable accuracy the progress made in mental acquirements, and there seems to be no good reason why the methods of training the body should not be subjected to similar tests. Periodical physical measurements stand in the same relation to bodily training as stated examinations stand to mental education; and, if the latter are considered essential portions of a plan of instruction, there is no reason why the former should not be regarded as of equal importance.

It seems desirable, also, that the fact, distinctly brought out in this investigation, that the rate of growth varies greatly at different periods of the school-life, should be recognized in the allotment of the studies of the school-course; for it is manifestly unwise to demand the maximum of mental effort at a period when the vital energies are most in demand for the growth and development of the physique.

DISEASE OF THE MIND.

By CHARLES F. FOLSOM, M. D., Secretary of the Board.

The Board believe that this paper will present many points of interest to all those who hope for amelioration, constant and progressive, in the treatment of the insane. The writer shows, by citing well-known historical facts, that during the past century very great strides have been made in the treatment of mental disease. The foreign correspondence, and the opinions of a few of our American superintendents, are especially valuable in this respect. They seem to prove that the more we can treat the insane as persons possessed of a certain amount of reason, and that the more we can arrange our asylums so as to resemble private homes and residences, the greater will be our success in restoring to perfect health

this unfortunate class of our fellow-citizens, and the more complete our satisfaction in making their lives as happy as possible.

As regards supervision of the insane, the writer agrees with the late Dr. Samuel G. Howe, that "All human institutions are of course liable to abuse; but our Massachusetts hospitals for lunatics are as well guarded against them as any public establishments with which I am familiar." At the same time, there are many reasons why a more methodical inspection than now exists in our State would be likely to be productive of good.

If the plan suggested by Dr. Stearns, Medical Superintendent of the "Retreat" at Hartford, could be carried out—namely, that a competent commission in lunacy be appointed by the harmonious coöperation of the New England States, great good would be certain to come from it.

Our most serious need at the present time, so far as this subject is concerned, is considered to be thorough clinical instruction in mental disease in our medical schools. Thus far, there is no place in the United States, except New York, where this is done, and no medical school of importance in England, France, Germany, or Scotland where it is not done.

HEALTH OF TOWNS.

We desire to express our thanks to our correspondents in the different parts of the State for their hearty coöperation with the Board in securing information affecting the public health during the past year.

There are still very few local boards of health in the State independent of the regular town officers. The striking benefit which has followed their establishment in some of the towns in the State, and notably in Boston, is of itself marked evidence of their value.

In our correspondence under this head will be found useful and suggestive facts in regard to the predisposing causes of diphtheria, as it appeared during the past year. The investigations in Lowell, Lynn and Salem, in regard to circumstances attending its appearance, will be found especially valuable.

The epidemic of typhoid fever, described by our correspondent in South Dennis, is well worth careful attention.

We thank the registrars of the more populous places in the State for their politeness in furnishing us each week the statistics from which the schedules of mortality are published each Thursday morning in the "Boston Daily Journal." These are not as complete as they might be, and we cannot yet furnish a full and accurate statement of the weekly prevailing fatal diseases. If more general and extensive reports could be sent to us each week, as is entirely practicable with a slight modification in our laws on registration, the Board believe that great good would be got by the community at a very trifling cost.

As the metric system is likely to come into general use at no distant day, and as its simplicity readily commends itself to the public, a table of equivalent values is given, as was done last year.

The Board have expended nearly the whole of their appropriation for the year's work, of which about four hundred dollars were used for the Centennial Exhibition, and a little more than the same amount in the preparation of drawings, surveys, etc., for publication in the Seventh Report.

All of which is very respectfully submitted.

HENRY I. BOWDITCH,
ROBERT T. DAVIS,
RICHARD FROTHINGHAM,
DAVID L. WEBSTER,
JOHN C. HOADLEY,
THOMAS B. NEWHALL,
CHARLES F. FOLSOM,

Members of the State Board of Health.

THE METRIC SYSTEM.

LENGTH.

1 Myriameter .	. Mm	(10,000 m)	= 6.2137 miles.
1 Kilometer .	. Km	(1,000 m)	= 0.62137 mile.
1 Hectometer .	. Hm	(100 m)	= 328.0833 feet.
1 Decameter .	. Dm	(10 m)	= 393.7 inches.
1 Meter .	. m	(1 m)	= 39.37 inches.
1 Decimeter .	. dm	(0.1 m)	= 3.937 inches.
1 Centimeter .	. cm	(0.01 m)	= 0.3937 inch.
1 Millimeter .	. mm	(0.001 m)	= 0.03937 inch.

SURFACE.

1 Hectare .	. Ha	(10,000 sq. m)	= 2.471 acres.
1 Are .	. a	(100 sq. m)	= 119.6 square yards.
1 Centare .	. ca	(1 sq. m)	= 1,550 square inches.

CAPACITY.

1 Kiloliter or Stère .	Kl or st.	(1000 l.)	= 1.308 cubic yards	= 264.17 gallons.
1 Hectoliter .	. Hl	(100 l.)	= 2 bushels & 3.35 p'ks	= 26.417 "
1 Decaliter .	. Dl	(10 l.)	= 9.08 quarts	= 2.6417 "
1 Liter .	. l	(1 l.)	= 0.908 quart	= 1.0567 qts. (1.761 imperial pts.)
1 Deciliter .	. dl	(0.1 l.)	= 6.1022 cubic inches	= 0.845 gill.
1 Centiliter .	. cl	(0.01 l.)	= 0.61022 cubic inch	= 0.338 fluid ounce.
1 Milliliter .	. ml	(0.001 l.)	= 0.061 cubic inch	= 0.27 fluid drachm.

WEIGHT.

1 Millier or Tonneau M or T	(1,000 Kg)	= 1 Kl or 1 Cu m	= 2204.6 lbs. (avoirdupois.)
1 Quintal .	. Q	(100 Kg)	= 1 Hl or 0.1 Cu m = 220.46 "
1 Myriagram .	. Mg	(10 Kg)	= 1 Dl or 10 Cu dm = 22.046 "
1 Kilogram .	. Kg	(1,000 g)	= 1 l or 1 Cu dm = 2.2046 "
1 Hectogram .	. Hg	(100 g)	= 1 dl or 0.1 Cu dm = 3.5274 ounces.
1 Decagram .	. Dg	(10 g)	= 1 cl or 10 Cu cm = 0.3527 ounce.
1 Gram .	. g	(1 g)	= 1 ml or 1 Cu cm = 15.432 grains.
1 Decigram .	. dg	(0.1 g)	= 0.1 ml or 0.1 Cu cm = 1.5432 "
1 Centigram .	. cg	(0.01 g)	= 0.01 ml or 10 Cu mm = 0.1543 grain.
1 Milligram .	. mg	(0.001 g)	= 0.001 ml or 1 Cu mm = 0.0154 "

One kilogram is equal to a weight represented by one liter of distilled water at 4° C. In the centigrade scale 0 (32° + F.) is the freezing-point; 100° + (212° + F.) is the boiling-point. Five degrees C. correspond to nine degrees F.

All measures in the metric system are derived from the meter, and their names express their values. Some of the names in the French system (like our "dime") are not in practical use; e. g., hectometer, decagram, etc.

One inch = 2.5 centimeters nearly; one quart (wine measure) = 0.946 liter; one pound troy = 0.373 kilogram; one acre = 0.4046 hectare.

EXPENSES OF THE BOARD.

Republishing "Fifth Diseases,"	\$140 00
Traveling Expenses,	144 01
Messenger,	50 30
Publishing Summary of Seven Years,	267 79
T. H. Hay, clerical services,	173 75
Express and freight,	190 68
Telegrams,	1 76
Investigations and clerical services on Infant Mortality,	363 50
Investigations and clerical labor on Consumption,	167 80
Surveys in Boston,	10 00
Examinations of ice-supply at Pittsfield,	44 50
Inspection of hospital in Illinois,	20 00
Drawings of Brighton Abattoir,	125 00
Carriage and horse hire,	21 00
Indexing Seventh Report,	32 50
Boston "Journal,"	29 24
Sheriffs, serving notices,	20 36
Examination of Nashua River,	585 10
Maps and drawings for reports,	227 20
Maps and surveys of Lynn,	180 00
Chemical analyses (Lynn),	38 75
Translation for Seventh Report,	30 00
Books and binding,	264 59
Postage and stationery,	241 20
Printing " "	134 45
Furniture,	44 06
Miscellaneous,	8 58
Special investigations and reports (H. P. Bowditch, E. G. Cutler, E. S. Chesbrough, A. H. Johnson, F. Nickerson, F. E. Oliver, J. G. Pinkham),	1,443 55
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	\$4,999 67

**THE POLLUTION OF STREAMS, DISPOSAL OF
SEWAGE, ETC.;**

BY THE SECRETARY OF THE BOARD.

WITH CHEMICAL EXAMINATIONS,

By WM. RIPLEY NICHOLS,

Professor of General Chemistry in the Massachusetts Institute of Technology;

AND

WITH A MAP OF THE NASHUA RIVER BASIN,

By EDWARD K. CLARK, C. E.

THE POLLUTION OF STREAMS.

"It has long been amongst the most fixed of the certainties which have relation to civilized life, that, wherever human population resides, the population cannot possibly be healthy, cannot possibly escape recurrent pestilential diseases, unless the inhabited area be made subject to such skilled arrangements as shall keep it habitually free from the excrements of the population."—SIMON.

A single river-basin has been examined by the Board during the year, and that has been selected which offers the most topics for consideration, being situated in two States, being polluted at many points, and illustrating most of the important features that would be likely to govern legislation, if any should be thought advisable.

A brief *résumé* has also been prepared of the advance in this branch of knowledge during the year, including the strictly sanitary bearing of improper, inefficient, or incomplete methods of disposing of filth.

The proper construction of sewers has seemed of such vast importance to the Board, and one needing such general attention in all our cities and in many of our towns at the present time, that one of the most eminent and accomplished engineers has been engaged to prepare a paper on that subject.

That the water-carriage system, where it is practicable, is the only admissible method of disposing of the refuse of houses in large and highly civilized communities, there can be no doubt. The best substitutes for water-carriage, where any must be used, have been considered fully in the seventh report of the State Board of Health.

THE NASHUA RIVER BASIN.

A careful survey, based upon the county maps, and a personal exploration of the country itself, was made during the past summer by Mr. E. K. Clark, C. E., who also prepared the accompanying map.*

* See page 70.

A circular was then sent to the medical correspondents of the Board, and to the chairmen of the selectmen of all the towns and the one city within the drainage-area of the Nashua River in our State, and later, to Nashua and to the three towns of New Hampshire which drain into the river, asking replies to the following questions :—

I. Is there any pollution of ponds or streams in your town arising from—

(a) manufactories or mills ;

(b) town-sewage, etc. ?

II. If so, what is—

(a) the character of the pollution (lime, dyestuffs, excrement, street washings, etc.) ;

(b) its extent (effect on color, smell, etc., of the stream, influence on fish, etc., whether offensive, unfit for cattle to drink, etc.) ?

III. Does the offensive matter, if any, come from your own town, or from another ?

IV. What is the source of your water-supply ?

(b) Is it free from contamination ?

V. Are there *any complaints* from manufacturers, or others, of the pollution of streams in your town ?

VI. Have you any suggestions to offer as to the drainage of the soil, or the sewerage of your town ?

After returns had been received from all the towns in Massachusetts to which they had been sent, they were carefully compared with Mr. Clark's notes, and the places most requiring attention were visited by Professor Nichols and the Secretary of the Board. Later still, in September, and twice in October, a more extended survey was made by the Secretary ; and, during the last four examinations, specimens of water were collected for chemical analysis.

From these several sources of information, chiefly, the following account has been prepared.

Area and Population.

The area drained by the Nashua River within the State is 457 square miles ; in New Hampshire, 82 square miles. The country is not densely populated, there being about 48,000 persons, making an average of 106.5 to each square mile of

the portion within Massachusetts; and there is not one large city. The occupation of the inhabitants is largely farming, although in several places manufacturing interests have sprung up, which have contributed almost wholly to any serious pollution of the streams which may exist.

The following table shows the distribution and movement of the population in the last twenty years. The total number of inhabitants in 1875 is somewhat larger than that given by Mr. Clark, as there are a few towns which do not lie wholly within the Nashua Basin, but have villages of some size outside of it. Such places as Gardner, Hubbardston, and others, which have only very small and sparsely populated portions in this drainage-area, are not given in the list.

TABLE I.—*Population of Towns in Nashua Basin in Massachusetts.*

TOWNS.	Sq. Miles within Drainage-area.	Whole Area of Towns in Sq. Miles.	Population in 1855.	Population in 1865.	Population in 1875.	Increase per cent. 1855 to 1865.*	Increase per cent. 1865 to 1875.*	Increase per cent. 1855 to 1875.*
Ashburnham, .	16.49	40.89	2,211	2,153	2,141	—	—	—
Ashby,† .	22.01	26.59	1,176	1,080	962	—	—	—
Ayer,‡ .	10.86	14.61	—	—	1,872	—	—	—
Bolton, .	9.59	21.40	1,255	1,502	987§	11.71	—	—
Boylston, .	12.20	19.95	835	792	895	—	13.00	7.18
Clinton, .	7.08	7.65	3,636	4,021	6,781	10.60	68.60	86.50
Dunstable, .	4.73	18.49	533	533	452	0	—	—
Fitchburg, .	30.33	30.33	6,442	8,118	12,289	26.00	51.40	90.76
Groton, .	18.61	32.91	2,745	3,176	1,908	15.70	16.76||	35.05||
Harvard, .	15.75	26.17	1,533	1,355	1,304	—	—	—
Holden, .	33.07	36.52	2,114	1,846	2,180	—	18.09	3.02
Lancaster, .	27.77	27.77	1,728	1,752	1,957	1.38	11.70	13.30
Leominster, .	29.52	29.52	3,200	3,313	5,201	3.53	56.90	60.30
Lunenburg, .	28.26	28.26	1,224	1,167	1,153	—	—	—
Pepperell, .	23.25	23.25	1,765	1,709	1,924	—	12.58	9.00
Princeton, .	33.13	37.75	1,317	1,239	1,063	—	—	—
Shirley, .	24.41	24.41	1,479	1,217	1,352	—	11.09	—
Sterling, .	30.33	30.33	1,838	1,668	1,569	—	—	—
Townsend, .	37.35	37.35	2,092	2,056	2,196	—	6.81	4.97
West Boylston, .	13.24	14.61	2,310	2,294	2,902	—	26.22	25.60
Westminster, .	28.71	37.91	1,979	1,639	1,712	—	4.45	—
	456.69	566.67	41,412	42,630	52,800	2.94	23.86	27.50

* Where there is no change, or an actual decrease, the signs 0 and — are used.

† The towns in Roman letters are in Worcester County; those in *italics*, in Middlesex.

‡ Made a town in 1871, taking about 75 of its population from Shirley and the rest from Groton.

§ About one-third of Bolton was set off in forming the town of Hudson.

|| Including 1,800 of the population of Ayer, which is about the number which would have belonged to Groton if the boundary lines of 1865 and 1855 had been kept.

It may be seen that there are only five places which have increased more than one-fifth since 1855. In Clinton and Fitchburg the manufactures which have been developed are of a kind to seriously pollute the streams. In Leominster, which owes its prosperity largely to comb factories, there is less refuse from the mills. Groton's increase in population (including Ayer) is due, partly at least, to its being a railroad centre, where trains meet from several important points. West Boylston, which has added only one-fourth to its numbers in a fifth of a century, does not yet discharge enough refuse into the streams to cause any complaints, so far as is known. The remaining towns, excepting a few villages in some of them, are chiefly engaged in farming, and have increased only slightly, or have actually diminished, in the last twenty years.

Water-Supply and Sewerage.

None of the towns have sewerage-systems, although a few sewers have been built in Fitchburg, Clinton and Leominster, chiefly for the removal of surface-drainage and the waste from some of the less polluting shops. Clinton and Fitchburg are about introducing sewerage-systems, or at least more sewers, and the same will probably be done at no distant day in Leominster. The trades, therefore, are the chief sources of pollution to the Nashua River, and they are such, more or less, pretty much throughout its entire length.

There are only two towns and one city containing over three thousand inhabitants; and they have got, or are about getting, abundant and satisfactory water-supplies without being dependent upon the river, except at its head-waters, where there is no pollution. The other towns rely upon springs or wells; and their water for domestic use is thought by our correspondents to be pure where not contaminated by such avoidable means as lead-pipe or improperly managed privies.

River-Statistics of the Nashua Basin.

The river-statistics of the Nashua Basin are now given as prepared by Mr. Edward K. Clark, C. E.

TABLE II.—Statistics of Nashua River.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Employed.	No. of Spindles.	Head and Fall in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of water below mill.
Branch from Chaffinville,	Satinet Mill, . . .	Holden, . . .	28	-	32	2	182,000 lbs.	Good.	Good.
	Satinet Mill, . . .	Holden, . . .	6	-	7	1	26,000 lbs.	Good.	Good.
	Cotton Mill, . . .	Holden, . . .	30	2,300	26	-	124,800 lbs.	Good.	Good.
	Cotton Mill, . . .	Holden, . . .	75	4,672	24	-	280,800 lbs.	Good.	Good.
Asnybunsket River, .	Woolen Mill, ¹ }	Holden, . . .	70	-	10	3	234,000 lbs.	Good. }	Discolored at times.
	Woolen Mill, ¹ }	Holden, . . .	70	-	12	3	234,000 lbs.	Good. }	Discolored at times.
	Shoddy Mill, . . .	Holden, . . .	3	-	18	-	4,000 lbs.	Good.	Good.
	Woolen Mill, ² . . .	Holden, . . .	120	-	46	3	240,000 lbs.	Good.	Usually clean.
Quinepoxet Brook, . .	Cotton Mill, . . .	Holden, . . .	30	2,500	17	-	54,000 lbs.	Excellent.	Good.
	Woolen Mill, ² . . .	Holden, . . .	50	-	27	4	120,000 lbs.	Good.	Colored at times.
	Shoddy Mill, . . .	Holden, . . .	3	-	12	-	-	-	-

¹ Use some logwood, vitriol, sal-soda, soda-ash and soap.² Use 5,000 lbs. logwood, 400 lbs. vitriol, 200 lbs. alum, 200 lbs. soap, per month; also some oxalic acid.³ Use 2,000 lbs. logwood, 200 lbs. vitriol, 1,200 lbs. soda-ash, 600 lbs. soap, per month; and do some coloring.

TABLE II.—Statistics of Nashua River—Continued.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Em- ployed.	No. of Spindles.	Head and Fall in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of efflu- ent.
Quinepoxet Brook, . . .	Cotton and Shoddy Mill, ¹	West Boylston, .	10	1,000	12	-	21,600 lbs.	Good.	Clean.
	Cotton Mill, . . .	West Boylston, .	60	3,800	24	-	216,000 lbs.	Good.	Good.
	Cotton Mill, . . .	West Boylston, .	45	3,312	15	-	162,000 lbs.	Good.	Good.
	Cotton Mill, . . .	West Boylston, .	160	1,000	28	-	594,000 lbs.	Good.	Colored at times.
Still River, . . .	Woolen Mill, . . .	West Boylston, .	90	-	28	5	336,000 lbs.	Good.	Colored at times.
	Cotton Mill, . . .	West Boylston, .	50	2,656	10	-	168,000 lbs.	Good.	Clean.
Nashua River, S. Branch,	Cotton Mill, . . .	West Boylston, .	160	-	16	-	514,800 lbs.	Good.	Clean.
	Cotton Mill, . . .	Boylston, .	125	1,300	14	-	-	Good.	Good.
	Cotton Mill, ² . . .	Clinton, .	1,200	30,000	28	-	1,620,000 lbs.	Good.	Considerably discolored.
	Comb Manufactory, . . .	Clinton, .	150	-	6	-	-	Impure.	Discolored.
	Yarn Factory, . . .	Lancaster, .	25	2,000	8	-	156,000 lbs.	Good.	Good.
	Carpet Company, ³ . . .	Clinton, .	550	-	4	-	-	Good.	Foul and of- fensive.
	Clinton Gas Works, . . .	Clinton, .	3	-	-	-	800 tons.	-	-
Stream forming Quilt Pond.	Yarn Factory, ⁴ . . .	Clinton, .	50	4,000	29	-	300,000 lbs.	Very bad.	Bad.

Wachusett Brook, . . .	Paper Mill, ⁶ . . .	Westminster, .	-	-	-	40	-	-	-	-
Nashua River, N. Branch,	Paper Mill, ⁶ . . .	Westminster, .	-	-	-	13	-	-	-	-
	Paper Mill, ⁶ . . .	Fitchburg, .	33	-	1,500,000 lbs.	21	-	Good.	Discolored.	
	Paper Mill, ⁷ . . .	Fitchburg, .	27	-	1,300 tons.	27	-	Not pure.	Discolored.	
	Mowing-Machine Knives, .	Fitchburg, .	50	-	-	21	-	Not pure.	Unchanged.	
	Paper Mill, ⁸ . . .	Fitchburg, .	28	-	936 tons.	16	-	Not pure.	Much colored at times.	
	Mowing-Machine Manufac'y, .	Fitchburg, .	30	-	-	12	-	Dirty.	Unchanged.	
	Paper Mill, . . .	Fitchburg, .	36	-	950 tons.	15	-	Impure.	Discolored.	
	Flour Mill, . . .	Fitchburg, .	4	-	-	7	-	Not clean.	Unchanged.	
	Wood-Pulp Mill, ⁹ . . .	Fitchburg, .	6	-	-	11	-	Impure.	Unchanged.	
	Worsted Mill, ⁹ . . .	Fitchburg, .	-	-	-	11	-	-	-	
	Cotton Mill, . . .	Fitchburg, .	50	3,700	648,000 lbs.	11	-	Not good.	Unchanged.	
	Woolen Mill, ¹⁰ . . .	Fitchburg, .	70	-	170,000 lbs.	10	4	Not very good.	Colored at times.	
	Fitchburg Gas Works, . . .	Fitchburg, .	3	-	740 tons.	-	-	Not very clean.	Unchanged.	
	Machine Company, . . .	Fitchburg, .	200	-	-	12	-	Not very clean.	Unchanged.	

¹ Shoddy mill picks eight tons stock per month.

² Use 10 bbls. lime, one ton chloride of lime, per month; vitriol, sal-soda; and do considerable coloring.

³ Use about 5,000 lbs. of soap per month; do a large amount of scouring and coloring.

⁴ Use 8,400 lbs. chloride of lime, 500 lbs. soda-ash, 216 lbs. vitriol, per month.

⁵ Not in operation.

⁶ Use 8 casks chloride of lime, 12,000 lbs. soda-ash, 4 tons alum, per month.

⁷ Use 7,200 lbs. chloride of lime, 4,000 lbs. alum, 400 lbs. bluing, per month.

⁸ Use 3,200 lbs. chloride of lime per month.

⁹ Use no chemicals.

¹⁰ Use 3,000 lbs. logwood, 3,000 lbs. fustic, 300 lbs. indigo, 700 lbs. soda-ash, 6½ bbls. soap, per month.

TABLE II.—Statistics of Nashua River—Continued.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Em- ployed.	No. of Spindles.	Head and Fall in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of efflu- ent.
Quinepoxet Brook, . .	Cotton and Shoddy Mill, ¹ .	West Boylston, .	10	1,000	12	-	21,600 lbs.	Good.	Clean.
	Cotton Mill, . . .	West Boylston, .	60	3,800	24	-	216,000 lbs.	Good.	Good.
	Cotton Mill, . . .	West Boylston, .	45	3,312	15	-	162,000 lbs.	Good.	Good.
Still River, . . .	Cotton Mill, . . .	West Boylston, .	160	1,000	28	-	594,000 lbs.	Good.	Colored at times.
	Woolen Mill, . . .	West Boylston, .	90	-	28	5	336,000 lbs.	Good.	Colored at times.
Nashua River, S. Branch,	Cotton Mill, . . .	West Boylston, .	50	2,656	10	-	168,000 lbs.	Good.	Clean.
	Cotton Mill, . . .	West Boylston, .	160	-	16	-	514,800 lbs.	Good.	Clean.
	Cotton Mill, . . .	Boylston, . .	125	1,300	14	-	-	Good.	Good.
	Cotton Mill, ² . . .	Clinton, . .	1,200	30,000	28	-	1,620,000 lbs.	Good.	Considerably discolored.
	Comb Manufactory, . .	Clinton, . .	150	-	6	-	-	Impure.	Discolored.
	Yarn Factory, . . .	Lancaster, . .	25	2,000	8	-	156,000 lbs.	Good.	Good.
Stream forming Quilt Pond.	Carpet Company, ³ . .	Clinton, . .	550	-	4	-	-	Good.	Foul and of- fensive.
	Clinton Gas Works, . .	Clinton, . .	3	-	-	-	800 tons.	-	-
	Yarn Factory, ⁴ . . .	Clinton, . .	50	4,000	29	-	300,000 lbs.	Very bad.	Bad.

Wachusset Brook, . . .	Paper Mill, ⁶ . . .	Westminster, .	-	-	40	-	-	-	-	-	-	-
	Paper Mill, ⁶ . . .	Westminster, .	-	-	13	-	-	-	-	-	-	-
Nashua River, N. Branch,	Paper Mill, ⁶ . . .	Fitchburg, .	33	-	21	-	1,500,000 lbs.	Good.	Discolored.			
	Paper Mill, ⁷ . . .	Fitchburg, .	27	-	27	-	1,300 tons.	Not pure.	Discolored.			
	Mowing-Machine Knives, .	Fitchburg, .	50	-	21	-	-	Not pure.	Unchanged.			
	Paper Mill, ⁸ . . .	Fitchburg, .	28	-	16	-	936 tons.	Not pure.	Much colored at times.			
	Mowing-Machine Manuffac'y, .	Fitchburg, .	30	-	12	-	-	Dirty.	Unchanged.			
	Paper Mill, . . .	Fitchburg, .	36	-	15	-	950 tons.	Impure.	Discolored.			
	Flour Mill, . . .	Fitchburg, .	4	-	7	-	-	Not clean.	Unchanged.			
	Wood-Pulp Mill, ⁹ . . .	Fitchburg, .	6	-	11	-	-	Impure.	Unchanged.			
	Worsted Mill, ⁹ . . .	Fitchburg, .	-	-	11	-	-	-	-			
	Cotton Mill, . . .	Fitchburg, .	50	3,700	11	-	648,000 lbs.	Not good.	Unchanged.			
	Woolen Mill, ¹⁰ . . .	Fitchburg, .	70	-	10	4	170,000 lbs.	Not very good.	Colored at times.			
	Fitchburg Gas Works, . . .	Fitchburg, .	3	-	-	-	740 tons.	Not very clean.	Unchanged.			
	Machine Company, . . .	Fitchburg, .	200	-	12	-	-	Not very clean.	Unchanged.			

¹ Shoddy mill picks eight tons stock per month.

² Use 10 bbls. lime, one ton chloride of lime, per month; vitriol, sal-soda; and do considerable coloring.

³ Use about 5,000 lbs. of soap per month; do a large amount of scouring and coloring.

⁴ Use 8,400 lbs. chloride of lime, 500 lbs. soda-ash, 216 lbs. vitriol, per month.

⁵ Not in operation.

⁶ Use 8 casks chloride of lime, 12,000 lbs. soda-ash, 4 tons alum, per month.

⁷ Use 7,200 lbs. chloride of lime, 4,000 lbs. alum, 400 lbs. bluing, per month.

⁸ Use 3,200 lbs. chloride of lime per month.

⁹ Use no chemicals.

¹⁰ Use 3,000 lbs. logwood, 3,000 lbs. fustic, 300 lbs. indigo, 700 lbs. soda-ash, 6½ bbls. soap, per month.

TABLE II.—Statistics of Nashua River—Continued.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Em- ployed.	No. of Spindles.	Head and Fall in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of efflu- ent.
Quinepoxet Brook, . . .	Cotton and Shoddy Mill, ¹	West Boylston, .	10	1,000	12	-	21,600 lbs.	Good.	Clean.
	Cotton Mill, . . .	West Boylston, .	60	3,800	24	-	216,000 lbs.	Good.	Good.
	Cotton Mill, . . .	West Boylston, .	45	3,312	15	-	162,000 lbs.	Good.	Good.
	Cotton Mill, . . .	West Boylston, .	160	1,000	28	-	594,000 lbs.	Good.	Colored at times.
	Woolen Mill, . . .	West Boylston, .	90	-	28	5	336,000 lbs.	Good.	Colored at times.
Still River, . . .	Cotton Mill, . . .	West Boylston, .	50	2,656	10	-	168,000 lbs.	Good.	Clean.
	Cotton Mill, . . .	West Boylston, .	160	-	16	-	514,800 lbs.	Good.	Clean.
	Cotton Mill, . . .	Boylston, . . .	125	1,300	14	-	-	Good.	Good.
	Cotton Mill, ² . . .	Clinton, . . .	1,200	30,000	28	-	1,620,000 lbs.	Good.	Considerably discolored.
	Comb Manufactory, . . .	Clinton, . . .	150	-	6	-	-	Impure.	Discolored.
Nashua River, S. Branch,	Yarn Factory, . . .	Lancaster, . . .	25	2,000	8	-	156,000 lbs.	Good.	Good.
	Carpet Company, ³ . . .	Clinton, . . .	550	-	4	-	-	Good.	Foul and of- fensive.
	Clinton Gas Works, . . .	Clinton, . . .	3	-	-	-	800 tons.	-	-
	Yarn Factory, ⁴ . . .	Clinton, . . .	50	4,000	29	-	300,000 lbs.	Very bad.	Bad.
	Stream forming Quilt Pond.								

1877.]

THE POLLUTION OF STREAMS.

Wachusset Brook, . . .	Paper Mill, ⁶ . . .	Westminster, . .	-	-	40	-	-	-	Good.	Discolored.
	Paper Mill, ⁶ . . .	Westminster, . .	-	-	13	-	-	-		
Nashua River, N. Branch,	Paper Mill, ⁶ . . .	Fitchburg, . .	33	-	21	-	1,500,000 lbs.	-		
	Paper Mill, ⁷ . . .	Fitchburg, . .	27	-	27	-	1,300 tons.	-	Not pure.	Discolored.
	Mowing-Machine Knives, . .	Fitchburg, . .	50	-	21	-	-	-	Not pure.	Unchanged.
	Paper Mill, ⁸ . . .	Fitchburg, . .	28	-	16	-	936 tons.	-	Not pure.	Much colored at times.
	Mowing-Machine Manufac'y, . .	Fitchburg, . .	30	-	12	-	-	-	Dirty.	Unchanged.
	Paper Mill, . . .	Fitchburg, . .	36	-	15	-	950 tons.	-	Impure.	Discolored.
	Flour Mill, . . .	Fitchburg, . .	4	-	7	-	-	-	Not clean.	Unchanged.
	Wood-Pulp Mill, ⁹ . . .	Fitchburg, . .	6	-	11	-	-	-	Impure.	Unchanged.
	Worsted Mill, ⁹ . . .	Fitchburg, . .	-	-	11	-	-	-	-	-
	Cotton Mill, . . .	Fitchburg, . .	50	3,700	11	-	648,000 lbs.	-	Not good.	Unchanged.
	Woolen Mill, ¹⁰ . . .	Fitchburg, . .	70	-	10	4	170,000 lbs.	-	Not very good.	Colored at times.
	Fitchburg Gas Works, . .	Fitchburg, . .	3	-	-	-	740 tons.	-	Not very clean.	Unchanged.
	Machine Company, . .	Fitchburg, . .	200	-	12	-	-	-	Not very clean.	Unchanged.

¹ Shoddy mill picks eight tons stock per month.

² Use 10 bbls. lime, one ton chloride of lime, per month; vitriol, sal-soda; and do considerable coloring.

³ Use about 5,000 lbs. of soap per month; do a large amount of scouring and coloring.

⁴ Use 8,400 lbs. chloride of lime, 500 lbs. soda-ash, 216 lbs. vitriol, per month.

⁵ Not in operation.

⁶ Use 8 casks chloride of lime, 12,000 lbs. soda-ash, 4 tons alum, per month.

⁷ Use 7,200 lbs. chloride of lime, 4,000 lbs. alum, 400 lbs. bluing, per month.

⁸ Use 3,200 lbs. chloride of lime per month.

⁹ Use no chemicals.

¹⁰ Use 3,000 lbs. logwood, 3,000 lbs. fustic, 300 lbs. indigo, 700 lbs. soda-ash, 64 bbls. soap, per month.

TABLE II.—Statistics of Nashua River—Continued.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Em- ployed.	No. of Spindles.	Head and Fall, in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of efflu- ent.
Nashua River, N. Branch,	Flour Mill, . . .	Fitchburg, .	10	-	10	-	-	Not clean.	Unchanged.
	Machine Shop, . . .	Fitchburg, .	60	-	11	-	-	Not clean.	Unchanged.
	Paper Mill, ¹ . . .	Fitchburg, .	39	-	18	-	1,040 tons.	Not very clean.	Discolored.
	Cotton Mill, ² . . .	Fitchburg, .	-	-	16	-	-	-	-
	Cotton-Duck Mill, . . .	Fitchburg, .	100	5,000	18	-	561,600 lbs.	Fair.	Unchanged.
	Scythe Shop, ³ . . .	Fitchburg, .	-	-	12	-	-	-	-
	Paper Mill, ³ . . .	N. Leominster, .	30	-	8	-	150,000 lbs.	Not clean.	Colored.
	Tannery, ⁴ . . .	N. Leominster, .	75	-	-	-	20,000 hides.	-	-
	Tannery, . . .	N. Leominster, .	12	-	-	-	4,000 hides.	Clean.	Highly offen- sive.
	Leather-Board Manufactory, ⁵	Leominster, .	32	-	10	-	650 tons.	Fair.	Colored red at times.
A small brook, . . .	Linen Mill, ⁶ . . .	Leominster, .	22	732	10	-	104,000 lbs.	Fair.	Colored.
	Leather-Board Mill, ⁷ . . .	Lancaster, .	10	-	9	-	438,000 lbs.	Fair.	Colored red at times.
	Cotton Mill, . . .	Lancaster, .	60	2,376	15	-	163,800 lbs.	Good.	Unchanged.
Whitman's River, . . .	Paper Mill, . . .	Fitchburg, .	25	-	24	-	900,000 lbs.	Good.	Somewhat colored.

Phillips Brook,	Paper Mill, ¹	.	.	.	Fitchburg, .	-	-	25	-	-	-	-
	Cotton Mill,	.	.	.	Ashburnham,	44	1,500	22	-	187,200 lbs.	Very good.	Good.
	Chair Manufactory,	.	.	.	Ashburnham,	80	-	12	-	-	Good.	Good.
	Tub Manufactory,	.	.	.	Ashburnham,	15	-	6	-	-	Good.	Good.
	Tannery and Morocco Goods,	.	.	.	Ashburnham,	18	-	9	-	1,000 hides.	Good.	Somewhat colored.
	Chair Manufactory,	.	.	.	Ashburnham,	200	-	20	-	-	Good.	Good.
	Cotton Mill,	.	.	.	Ashburnham,	20	1,300	35	-	70,200 lbs.	Good.	Good.
	Woolen Mill, ²	.	.	.	Fitchburg, .	50	-	16	3	182,000 lbs.	Good.	Colored at times.
	Edge-Tool Company,	.	.	.	Fitchburg, .	15	-	15	-	-	Good.	Not changed.
	Paper Mill,	.	.	.	Fitchburg, .	12	-	18	-	730 tons.	Fair.	Colored.
Nookagee Brook,	Paper Mill, ³	.	.	.	Fitchburg, .	10	-	25	-	730 tons.	Impure.	Colored.
	Woolen Mill, ¹⁰	.	.	.	Fitchburg, .	50	-	19	3	105,000 lbs.	Not good.	Dirty.
	Woolen Mill,	.	.	.	W. Fitchburg,	60	-	18	2	104,000 lbs.	Bad.	Bad.
	Comb Manufactory,	.	.	.	Leominster,	10	-	15	-	-	Good.	Good.
	Comb Manufactory,	.	.	.	Leominster,	15	-	14	-	-	-	-
	Comb Manufactory,	.	.	.	Leominster,	25	-	15	-	-	-	-
Monoosnoc Brook,		.	.	.								
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¹ Use 12,800 lbs. soda-ash, 5,600 lbs. alum, 32 bbls. lime, per month.
² Not in operation.
³ Use 9,000 lbs. chloride of lime per month.
⁴ Do not use water-power; use spring-water for washing hides.
⁵ Use Indian-red for coloring-matter.
⁶ Use chloride of lime and soda-ash.
⁷ Use 40 bbls. Venetian-red, 20 carboys sulphuric acid, 13 bbls. lime, per month.
⁸ Use 1,600 lbs. logwood, 4,000 lbs. soda-ash, per month.
⁹ Use a good deal of chloride of lime.
¹⁰ Use 2,400 lbs. logwood, 1,800 lbs. soda-ash, per month.

TABLE II.—Statistics of Nashua River—Concluded.

NAME OF STREAM OR RIVER.	DESCRIPTION OF MILL.	Location.	No. of Hands Employed.	No. of Spindles.	Head and Fall, in Feet.	Sets of Machinery.	Amount of Stock used per year, so far as known.	Appearance of water above mill.	Appearance of effluent.
Monooksoc Brook, . .	Comb Manufactory, . .	Leominster, .	10	-	15	-	-	-	-
	Comb Manufactory, . .	Leominster, .	10	-	10	-	-	Fair.	Fair.
	Woolen Mill, ¹ . .	Leominster, .	60	-	14	4	234,000 lbs.	Fair.	Colored at times.
	Comb Manufactory, . .	Leominster, .	20	-	4	-	-	Dirty.	Unchanged.
	Comb Manufactory, . .	Leominster, .	25	-	3	-	-	Bad.	Bad.
	Comb Manufactory, ² . .	Leominster, .	65	-	12	-	-	Fair.	Unchanged.
Nonacanicus Brook, . .	Paper Mill, . .	Harvard, .	4	-	13	-	240 tons.	Good.	Colored at times.
	Tannery, ³ . .	Ayer, .	75	-	-	-	22,500 hides.	Good.	Bad.
	Paper Mill, ⁴ . .	Shirley, .	4	-	18	-	50 tons jute.	Good.	Discolored.
	Cotton Mill, . .	Shirley, .	60	3,300	14	-	234,000 lbs.	Good.	Unchanged.
Bow Brook, . .	Cotton Mill, . .	Shirley, .	50	5,944	12	-	163,800 lbs.	Good.	Unchanged.
	Cotton Mill, . .	Shirley, .	100	-	20	-	585,000 lbs.	Good.	Unchanged.
	Leather-Board Mill, ⁵ . .	Shirley, .	15	-	12	-	300 tons.	Good.	Very much colored.
	Paper Mill, . .	Townsend, .	8	-	13	-	180 tons.	Good.	Unchanged.
Squannacook River, . .									

per month.
per month.
also some color
half ton alum, also some color

Nashua River, . . .	Paper Mill, ¹ . . .	Groton, . . .	10	-	11	-	Good.	Discolored at times.
	Leather-Board Mill, ⁷ . . .	Groton, . . .	30	-	16	900 tons manilla.	Good.	Discolored at times.
	Paper Mill, ⁸ . . .	Groton, . . .	40	-	8	000 tons.	Good.	Discolored at times.
	Paper Mill, ⁹ . . .	Groton, . . .	65	-	11	1,600 tons rags.	Good.	Discolored.
	Paper Mill, ¹⁰ . . .	Pepperell, . . .	35	-	7	720 tons.	Good.	Discolored at times.
Merrimack River, . . .	Paper Mill, ¹¹ . . .	Pepperell, . . .	15	-	9	-	Good.	-
	Leather-Board Mill, . . .	Pepperell, . . .	7	-	8	480 tons.	Good.	Discolored at times.
	Cotton-Batting Mill, ¹² . . .	Pepperell, . . .	13	-	8	3,500 lbs.	Good.	Fair.

¹ Use 400 lbs. logwood, 1,200 lbs. vitriol, 1,600 lbs. soda-ash, per month, and some soap.
² Use 1 bbl. lime per month.
³ Do not use water-power.
⁴ Use 6,000 lbs. chloride of lime, 500 lbs. alum, per month.
⁵ Use 15 casks Venetian-red per month, and some leather scraps and canvas.
⁶ Use 2 tons chloride of lime, 1,500 lbs. vitriol, per month.

⁷ Use Venetian-red for coloring.
⁸ Use 2 tons chloride of lime, 30 casks lime, half-ton vitriol, per month.
⁹ Use 3 tons chloride of lime, 750 lbs. vitriol, 750 lbs. alum, per month.
¹⁰ Use 1½ tons chloride of lime per month, some lime and alum, also some coloring-matter.
¹¹ Not in operation.
¹² Do some coloring.

The mills, generally speaking, discharge their refuse, including in many cases the house-offal from the tenements of the operatives, directly or indirectly into the streams. In a few cases, however, cesspools are used and their contents applied to the land. For the most part, the total refuse is small when compared with the volume of the stream, or it is cast in only at intervals, so that, judged by the eye, there is not a serious amount of pollution in many places. The appearances of the stream above and below each mill at the time of Mr. Clark's visits are given in the last two columns of the table.

Under the head of Remarks are given approximate statements of the chemicals, etc., used in the various processes. This is not assumed to be entirely accurate or complete, but will give a fair idea of the amount of the coarser refuse which finds its way into our rivers.

In some places the manufacturers complain of the foul condition of the water when it reaches them. Where it is used only for power, or for washing horn, it is not necessary that it should be pure. Occasionally spring-water is used for boilers, as the water of the river is too much polluted for that purpose. In Fitchburg, at one of the paper mills, the water is filtered before it can be used; at one of the woollen mills it is fit for dyeing dark but not light colors; at another woollen mill there is serious complaint of the condition of the water. Below the works of the carpet company in Clinton the water is so fouled by the gas works and by the scourings of wool, as to be a source of the greatest discomfort, if not of actual ill health, to the mill operatives below and to a large part of the town.

It will be seen, too, that foul or very offensive water, in the course of a few miles, loses its unsightly appearance altogether when not more concentrated than in the worst parts of the Nashua. Filthy, or at least turbid, pretty much through its whole course in Fitchburg, it is quite clear before reaching Leominster. The freshets of spring and autumn, too, scour out the river-bed so effectually as to prevent any serious accumulation of deposits from year to year; and, indeed, in some places, the great amount of earthy matter brought down in the stream at such times forbids the use of the water for manufacturing purposes.

At the time this examination was made, the river was rather high; so that the noticeable amount of pollution of the streams was much less than it would be in the latter part of summer. The mills, however, were in fuller operation than can be the case when the water is very low, although the depression in business had caused a few to run only a part of the time.

Saw mills are not included in the tables just given, although designated on the map. They employ very few men, and their only refuse—sawdust—is very easily, and should always, be kept out of the streams.

TABLE III.—Summary of Statistics of NASHUA RIVER.

[The letters F, D, etc., refer to the map at page 70.]

	F	D	G	H.	O	B	D	A	AA.
Drainage-area above point indicated, in square miles.	67	124	57	131	343	448	65	510 ^a	-
Drainage-area above where the Nashua joins the Merrimack.	-	-	-	-	-	-	-	-	639
Dry-weather flow at respective points in 24 hours, in cubic feet.	1,231,200	2,894,800	1,231,200	2,829,600	7,408,800	9,576,800	1,404,000	11,016,000	-
Dry-weather flow at respective points in U. S. gallons.	9,209,376	21,533,104	9,209,376	21,165,408	55,417,824	72,382,464	10,503,920	82,399,680	-
Number of polluting factories or mills.	14	25	21	48	81	87	3	92	-
Number of polluting factories or mills per square mile.	0.25	0.18	0.37	0.37	0.24	0.20	0.25	0.20	-
Number of operatives in said mills.*	800	3,163	687	1,776	5,303	5,408	35	5,443	-
Population above respective points, 1865,	2,750	10,000	4,700	16,000	33,750	38,800	900	39,700	-
Population above respective points, 1875,	3,000	14,100	5,600	22,200	43,200	47,800	1,000	48,800	-
Population above respective points per square mile,	53	106	98	169	128	111	83	109	-
Population of cities, villages, or mills now draining into river above said points,	1,800	8,500	3,000	8,000	20,000	25,000	400	28,600	-
Population of this character per square mile,	32	63	53	61	58	58	33	68	-

* Including a small part of New Hampshire.

^a These numbers include only the mills (86 in all) in operation at the time of the survey.

TABLE IV.—*Summary of Manufactories.**

	No. of Mills.	No. of Hands Employed.
Woolen Mills,	14	1,265
Shoddy Mills,	2	6
Cotton Mills,	22	2,478
Paper Mills,	20	437
Edge-tool and Machine Works,	6	350
Comb Manufactories,	9	330
Tanneries,	4	180
Chair and Tub Manufactories,	3	245
Leather-Board Mills,	5	94
Flour Mills,	2	14
Gas Works,	2	6
Linen Mill,	1	22
Wood-Pulp Mill,	1	6
Cotton and Shoddy Mill,	1	10
Total,	92	5,443

* Including 3 paper mills, 1 cotton mill, 1 worsted mill, and 1 scythe manufactory not in operation.

Pollution from Mills.

The character of the pollution from the various trades was given fully in the last report, so that only a brief statement will be made with regard to them here.

Woolen Mills.—The chemicals used are reported this year to be chiefly soap, soda-ash, sal-soda, chloride of lime, alum, blue vitriol, sulphuric acid, oxalic acid, indigo, logwood, fustic, and a few other coloring matters. Urine and dung are not now so much used as formerly. The chief sources of pollution are :

1. The "wool suds," consisting of soap or alkali and water, with the grease, waxy substance, and dirt removed from the wool,—a highly offensive mixture, and constituting about nine-tenths of the waste.
2. The "waste liquor" from the dye-vats, a concentrated fluid containing alum and coloring matters, which discolours streams, but does much less harm—in fact, to some degree, neutralizes the evil done by the animal refuse.
3. The water used in washing the dyed goods, and containing dyestuffs in small quantities, with a little glue and soap—not a source of serious harm.

A comparative analysis of these three waste fluids is given, as follows, in the third report of the Second Rivers Pollution Commission of England; the results are expressed in parts per 100,000 :—

TABLE V.—Waste Fluids from English Woolen Mills.

	DISSOLVED MATTERS.								SUSPENDED MATTERS.		
	Total Solid Mat- ters.	Organic Carbon.	Organic Nitro- gen.	Ammonia.	Nitrogen as Ni- trates and Ni- trites.	Total Combined Nitrogen.	Metallie Arsenic.		Mineral.	Organic.	Total.
Washing water from dyed and scoured goods, .	29.62	0.19	0.05	0.01	0.34	0.41	0.002		0.72	0.88	1.60
Waste liquid from woolen dye-vats, . . .	107.60	48.97	3.32	0.49	0	3.73	-		24.08	77.92	102.00
Waste liquor from wool scouring and washing, .	1,099.40	132.48	9.88	54.61	0	54.85	trace.		870.95	2,611.65	3,482.60

Cotton Mills.—In washing, bleaching, printing, and dyeing calico, most of the materials used find their way into the streams, as only a small quantity, consisting of starch and coloring matter, remains in the cloth. The substances used are madder, garancine (prepared madder), peachwood, logwood, sumach, starch, gum, dung, sulphuric acid, muriatic acid, soda-ash, "bleaching powders," lime, soap, arsenate of soda, bichromate of potash, acetate of lead, and some other dyes peculiar to different houses, and kept more or less secret. From such coarse substances as madder and logwood, the amount of refuse is very great, but they are not now so much used as the coloring matters extracted from them. In bleaching, the amount of pollution to the streams is not great, and consists chiefly of alkaline and soapy liquors, with some of the salts of lime, mostly insoluble, and soon subsiding in the form of a heavy precipitate. If the cotton is scoured and washed before use, the soapy and alkaline refuse is considerable. Dyeing, printing, and scouring are not done in many of the mills included in this examination.

Paper Mills.—Soda-ash, lime, chloride of lime, alum, and sulphuric acid are used. The processes which pollute the streams are the cleansing, while dry, of the dirty rags of which some of the paper is made; boiling the vegetable fibre or rags into pulp with alkali at high pressure, forming a soapy refuse, which is offensive to smell, and one of the most polluting fluids which is passed into the streams; washing this substance; bleaching with soap and lime, and in some cases coloring largely by means of arsenical and aniline dyes. Where paper is used as the raw material, and no coloring is done, of course the amount of refuse is small; and of the expensive dyes very little is wasted at best.

Comb manufactories discharge into streams chiefly washings from horns or hoofs, containing a certain amount of animal matter. They are not represented as being serious evils.

Tanneries have a considerable amount of waste in lime, hen-manure, and animal matter (*i. e.*, the washings or scrapings from the hides), forming a highly offensive compound. The spent "bark-liquor" does very little harm. In fact, that and the iron salts "disinfect," in a considerable degree, the

other refuse. The hair and "fleshings" are now universally saved.

Leather-Board Mills.—Lime and sulphuric acid are used in reducing the scraps of rope, canvas, leather, etc., to the suitable condition, and are finally wasted. In coloring, Venetian-red (one-third oxide of iron and two-thirds sulphate of lime) and Indian-red (nearly pure red oxide of iron) are employed, with a little alum. The streams are very much discolored near the mills when the refuse is discharged, but soon become nearly clear, as the matter is mostly insoluble, and readily settles.

Shoddy Mills.—There are two in Holden; and in West Boylston one cotton mill has a department for this work. They are not represented as casting any matters into the river from the processes of manufacture.

One linen mill (in Leominster) uses cotton yarn and flax tow for stock, cleansing and bleaching with chloride of lime and soda-ash.

Gas Works need not pollute streams at all. The tarry and ammoniacal refuse which they usually waste is offensive, mingles slowly with water, and is noticeable at a long distance from its point of discharge. It can be, and should be, saved.

Works for the manufacture of iron and wooden ware, and flour mills, of course, do not need consideration in this connection.

Saw Mills sometimes most needlessly fill up the river-beds with accumulations of sawdust.

There are no *chemical works* on the Nashua or its tributaries.

Survey of the Nashua Basin.

Mr. Clark's account of the basin of the Nashua River is as follows, dated June, 1876 :—

The southernmost branch of the Nashua River rises in the southern part of Holden, where there are two small woolen mills and a cotton mill. The stream receives but little pollution, as the mills do very little coloring or washing, and the village upon it has a small population. Asnybursket Brook rises in quite high land, and flows through the more central part of Holden, a village of about 2,500 inhabitants, receiving, beside the refuse from the woolen mills and one or two tanneries at this point, the drainage from a

few of the houses. The soil is sandy, and absorbs the surface-water readily. Quinepoxet Brook rises in the high land of Princeton, and upon it, at the village of Ruralville, are a small woolen and a cotton mill, employing, at both, about 80 hands. The water of these three streams, united to form the Quinepoxet River, has a rapid fall as it flows through the town of West Boylston.

Still River rises in the high and broken land of Princeton and Sterling, and receives only the surface-drainage from the very small villages of East Princeton and West Sterling, of which the soil is sandy. At Oakdale (population 1,000), in West Boylston, Still River joins Quinepoxet River, to form the south branch of the Nashua, and gives power to a cotton and woolen mill, employing about 250 hands. The water is very clear and light in color, but, at times, is discolored below the mills by the dyestuffs. The privies of the operatives discharge into the river.

After leaving the mills at Oakdale, the stream flows through West Boylston Centre (population about 3,000); it is used by the cotton mills at that place. The excrement, the only refuse from both mills, is allowed to go into the river. The sewage from the houses about the lower mill is carried directly to the land, and used upon it as a fertilizer. The village is very favorably situated to drain into the river, and the surface-drainage must be considerable; the soil is suitable for filtering such drainage.

In the town of Boylston, the river affords power to one cotton mill. In the next three or four miles, the fall is so gradual that the power is not used. At Clinton, the Lancaster Cotton Mills have a fall of 28'. Considerable bleaching and coloring is done at this mill; and the refuse from these processes, with the excrement from 1,200 operatives, goes into the stream, which is at times very much discolored as it leaves the mill; its usual appearance in summer is not that of clean river-water. Above the mills the water is clear, and is used by some families and by the operatives for domestic purposes. As a general thing, the houses about the mill are connected with cesspools, which are frequently cleaned.

About forty rods lower is a comb manufactory, employing about 150 hands. The only refuse from it is the water, in which horns are washed, with some lime and excrement from the factory. The water, as it comes to the place, is noticed to be impure, but causes no inconvenience. Not far below this manufactory the river receives the water of a small stream, which is the outlet for two or three ponds south of Clinton. The dam of the Clinton Yarn Company, which is on this stream, about one mile from the Nashua River, causes a pond to be made in about the centre of the town, which is situated on surrounding hills, with advantages for draining into this

basin. The Carpet Company are located above the pond, and have the first use of the water of the brook, which, in its natural state, is very pure ; but, as it leaves the manufactory, where it is used for dyeing and for washing large quantities of wool, it is dark and impure. This pond, situated as it is in the middle of the town, and made the receptacle of all kinds of refuse, is the source of intense annoyance, if not the cause of more serious troubles, to persons living in the vicinity. At the yarn factory, the foul gases and effluvia render some of the rooms almost uninhabitable ; and for manufacturing purposes, spring-water, of which there is an abundance near the mill, is necessarily used. These springs seem to be supplied from the stratum of water-bearing gravel, which underlies a portion of the town, and through which the water moves with such considerable velocity that, where cesspools are accidentally placed low enough to connect with it, they are kept constantly clean. Clinton has a population of 6,781, but no system of sewerage ; there are, however, two or three sewers brought directly into the pond, into which the gas works also discharge a good deal of refuse. Water will probably be introduced from Sandy Pond. About two miles south of Clinton, the south and north branches of the Nashua unite.

The southerly tributary of the north branch is the outlet for Meeting-House and Wachusett ponds, supplies power to two paper mills at present not in operation, and, in its course, receives the surface-drainage of Westminster and Wachusett villages (population 400 and 150 respectively). The stream is joined by the waters of Whitman's Brook, which rises in the south-western part of Ashburnham. The fall of the latter is utilized by several saw mills and chair manufactories. Both of these streams rise in quite elevated country ; along their courses the soil is sandy, and the hills are wholly granite. They supply power to several paper mills and machine-shops in the south-western part of Fitchburg ; the pollution from the latter is but little, while from the former it is sufficient to color the water as it leaves the mills, and to render it unfit for use in boilers.

The stream which comes in from the north rises in Ashburnham, and its rapid fall affords power for several mills at Ashburnham Centre. The water is very clear, and, as it is comparatively large in volume, is not perceptibly changed as it flows through the village. Ashburnham Centre has a population of about 2,000 ; the land is sandy and quite steep in its inclination toward the stream. In Fitchburg, the water is used by three woolen mills and two paper mills, all situated only a few rods apart. The upper privilege, where the water is good, is used by a small woolen mill for scouring and dyeing, and at times the effluent is discolored. It is then

taken by two paper mills manufacturing about four tons of stock per day; the woolen mills, still lower, complain of the condition of the water as it comes to them, and, as the volume of the stream is not large, the impurity is particularly noticeable during the summer months.

In passing through the city of Fitchburg, the Nashua River (north branch) is used by a large number of manufactories, all of which turn their refuse into it. The city has a population of about 12,000, and is supplied with water from Scott's Brook. No system of sewerage has been completed; there are, however, one or two brick and a few pipe sewers discharging into the river. A bad odor rises from the river at times, animals refuse to drink the water, and fish have almost entirely disappeared from this portion of it. The soil is largely composed of sand and gravel. The hills in the vicinity are high and almost wholly of granite.

At North Leominster, the water is used by a leather-board mill, manufacturing about 5,000 pounds of stock per day. Upon the high ground opposite this mill, there is a tannery employing 75 hands; and, a little higher up, another tannery, belonging to the same parties, is a source of very serious annoyance, as its refuse is discharged into a small brook, two feet or less wide, and running through the village of North Leominster; the surface-drainage is not here very great. About a mile lower, the river receives the water of Monoosnuc Brook, which flows through Leominster Centre (population about 3,000). The town is supplied with water collected in a reservoir at the head of Morse Brook, and the sewers already built discharge at a lower point into that stream just above one of the dams. The town sewage, with the refuse thrown into the water by the manufactories, will necessitate the completion of the sewerage system already proposed, and which provides for a sewer which shall intercept the smaller street sewers and have its final outfall below the town.

Two miles and a half below Leominster Centre is a linen mill where a large quantity of chloride of lime is used in bleaching; the refuse runs into the river and discolours it at times. A leather-board mill, about a mile below, manufactures 1,200 pounds of stock per day; the effluent is colored by the Venetian-red and lime used. At the cotton mill, a mile and half below this, the water is in appearance quite clean, and of light color.

From the point where the north and south branches of the Nashua unite, to the State line, the fall is very gradual; soil sandy.

Catecunamug Brook rises in the central part of Lunenburg. Its water is not available for power until it reaches Shirley, where it is used by a paper mill and three cotton mills. The refuse from the

paper mill discolours the water a little; the excrement from the cotton mills and the houses about them is usually collected in boxes and removed once or twice a year. Upon Bow Brook, which flows into one of the ponds in the Catecunamug, there is a small leather-board mill by which the water is colored very dark red, as may be observed through the pond and to some distance below. The effluent lime, sulphuric acid and coloring matter are said to have killed the fish which were formerly found in the pond.

Nonacanicus Brook joins the river at Ayer, a town of about 1,800 inhabitants, with no system of sewerage, although a single sewer has been built, with which a cheese factory and a few houses are connected; it also receives the surface-water from the street. A tannery pollutes a pond in the outskirts of the town. In Harvard, upon this stream, there are one or two small mills.

Squanacook Brook rises among the granite hills of Ashby, and flows with a very gradual fall through the soil of Townsend and Groton. The drainage along the river is small, and the greatest amount of refuse is from two paper mills in Groton, by which the water is colored a little.

Nissitisset River rises in New Hampshire, and joins the Nashua in Pepperell. Near the point where the two unite are a cotton-batting and a leather-board mill. Some coloring is done at the former, and the effluent water of the latter is colored at times.

The waters of the Nashua River and its tributaries, with the exceptions mentioned, are, so far as appearance goes, in a good condition, clear and light in color.

Replies of Correspondents.

Our correspondents report as follows:—

Ashburnham.—The height of land between the Merrimac and Connecticut valleys lies in this town. Our ponds and streams arise from springs within our limits; and we have no large manufactories which produce offensive matters. The main business is the manufacture of chairs; a *small* amount of leather dressing is done, but there is no complaint of pollution of waters below. This village is comparatively thickly settled—ground hilly—and it would be an easy matter to construct sewers under the principal streets, and, connecting them with the stream, allow all waste liquid from whatever source to pass off through them.

Ashby.—There is no pollution of ponds or streams.

Ayer.—There is no pollution except of a pond on a brook flowing into Nashua River, and I have never known any complaint. I have

not noticed any appreciable effect in the stream. Privies are universally used, and are not by any means properly taken care of. The soil is light, sandy, and porous, and generally well drained.

Bolton.—No pollution of streams. Night-soil is generally carted off once a year.

Boylston.—No complaint has ever been made of pollution of streams in Boylston.

Clinton.—All the water passing the dye, gas, and wool-washing house from the carpet company is contaminated, of dirty color and offensive smell, *sure death* to fish,* unfit for cattle to drink, and is collected in Quilt Pond.† I would suggest that the pond be drained and covered up for the health of the citizens. The Lancaster Mills are on a branch of the Nashua, and do not cause enough pollution to affect the fish one mile below.

Here is a pond of about two acres, directly in the heart of the town (population, 6,781), receiving the sewage of the gas works, and also the carpet company's sewage entire. The wool-wash is immense, and being largely of animal matter, the stench, when the pond is down, on a hot day, is *telling*. It is something that can be remedied by using a covered drain; and the owners of the pond can be bought for a fair sum. I will agree to get you names by the *thousands*, certifying that a nuisance is in their midst and should be abated.

Dunstable.—No manufactories in our town, except saw mills and a grist mill.

Fitchburg.—The water of the Nashua, in passing this city, is extensively polluted by the wash of nine paper mills, four woolen mills, two cotton mills, gas works, and other manufacturing establishments on or in the immediate vicinity of the stream. The water presents a dirty appearance, and people generally shrink from bathing in it. It receives the whole sewage of the city, so far as sewage is disposed of at all. The main sewer discharges into it at a point not far below the thickly settled portion of the city. Punch Brook is used for sewage purposes, and discharges into the Nashua about in the centre of our population. All the chemicals employed in paper mills and different manufacturing establishments—excrement, dyestuffs, etc., and street washings—find their way directly into the stream. The extent of the pollution is great. The color of the water is materially changed in its whole course through the city during low water. I have seen the water in a small canal below a woolen mill, of almost inky blackness, so as visibly to affect the main current some distance below in the main stream. The river is

* Eels even are killed.

† Formed by the dam of the yarn company below.

but little used by manufacturers, except as a motive power. I have heard complaints of the offensiveness of the water on account of sewage-contamination at the outlet of the sewer, and by those in Punch Brook. I know of no practicable way of getting rid of our sewage, except to discharge it into the Nashua River, and thus pollute the stream. That work has already been done by the manufacturing. I think the outlet of our sewer should have been carried farther down stream.

Groton.—We have two paper mills and one leather-board mill in the town, employing in all 90 hands. The lime-bleaching material and excrement from the cotton mills, and alum and Venetian-red from the leather-board mill, go into the river. The color or smell of the water, a short distance below, is not affected. It is thought to have no material influence on fish. Cattle drink it readily.

Harvard.—No complaints; the town is naturally drained.

Lancaster.—In the leather-board mill, 500 barrels of Venetian-red, 250 carboys of sulphuric acid, and 160 barrels of lime are used annually, a combination which must be destructive to fish and injurious for all domestic purposes. The south branch of the Nashua has been made destructive to fish by the sewage, mills, and gas works of Clinton. It is, in my opinion, none too soon that this wholesale poisoning of our rivers and streams should be checked.

Leominster.—The drainage from a tannery at the north village is dark in color and highly offensive to smell, particularly in the evening and night. Many of the inhabitants have complained of the offensiveness of the small stream running down from the tannery through the village.

Lunenburg.—No trades-pollution. The surface of this town is somewhat hilly, with no large tracts of marshy grounds. Still, if that thorough drainage of our moist lands which our agricultural interest demands should be made, the general healthfulness of the citizens would thereby be promoted.

Pepperell.—The pollution here consists of all the filth arising from the manufacture of paper at four mills; but there are no complaints.

Princeton.—No pollution from trades or town sewage.

Shirley.—On the Catecunamug, there is a mill for the manufacture of "leather board," at which they use a red mineral coloring matter, which at times colors the whole stream.* I think it drives the fish from the stream. Lime is used also to some extent. The above will also apply to some extent to the Squanacook, another tributary of the Nashua, which forms a portion of the boundary line between this town and Groton. The water is at times wholly unfit for cattle

* This is a mere brook, a couple of feet wide.

to drink. In the case of the Catecunamug, the offensive matter is introduced into the stream in this town; but a portion of the lime and coloring matter in the Squanacook comes from Groton.

All the streams passing through this town empty into the Nashua River. On the south is a stream called "Bow Brook," having its source in Fort Pond in Lancaster; on this stream, in Shirley South Village, is a mill for the manufacture of leather board; at a short distance below, the stream unites with Catecunamug Brook, which has its source about five miles above, in Whaloam Pond in Lunenburg. On the latter stream is a mill, used till recently in the manufacture of paper; on the union of these two are three cotton mills and one saw mill,—distance to the Nashua River about two miles. The leather-board mill uses from two to three hundred pounds of red clay daily,—nothing else, I am informed by the agent. The material used in the manufacture of the board is mainly the waste from boot and shoe factories. The clay is the coloring matter, though I am told that about one-third of it is incorporated in the article manufactured. The articles used in cleansing and bleaching the rags, ropes, etc., of which the paper is made, are chloride of lime and soda-ash, say one hundred pounds daily. The cotton mills run 14,000 spindles, and employ some 300 persons when in full operation. To each mill is attached a water-closet for daily use; a large part of the sink-drains of those living near the streams empty into these streams, so that from all these substances there must be considerable impure matter emptying into the Nashua River from this little village. There is a stream arising in the north-westerly part of Lunenburg and passing through the northerly part of this town, called Mulplus Brook, on which there are several saw, grist, and lumber mills. On the north of the town is the Squanacook River, a tributary of the Nashua; on this is a leather-board mill of much greater capacity than the one first described; but, as this is partly in Groton, I will add nothing farther in regard to it. On the Mulplus in Lunenburg, as well as in Shirley, are several mills for the sawing of various kinds of lumber. For many years the waste—the sawdust—has been sent adrift in the stream, and the effect has been not only to much obstruct the flow of water in many places, but to nearly destroy the brook-trout, which were formerly abundant in it and in the tributary brooks. In a pond of about one hundred acres, situated below the paper mill on Catecunamug Brook, sportsmen say pickerel have grown scarce since the mill began to be used for such purposes. We do not know that the sawdust has killed the trout and the chloride of lime the pickerel, but the facts as stated exist.

Sterling.—No trades-pollution; a small stream and a low, flat

meadow receive all the sewage that goes from the central village; and it remains in the ditches of this meadow, there not being any proper outlet. The meadow is in close proximity to the village.

Townsend.—There is no trades-pollution, unless, possibly, from decaying sawdust, of which there are large quantities in our river. I have often noticed that, in the vicinity of the largest sawdust beds, the water has a darker look. As the water is so variable as to height, there must be a decay going on in the warm season. I never knew cattle to refuse to drink from the river.

West Boylston.—There is some trades-pollution, but it is so small that it cannot be detected in the water by smell or taste.

Westminster.—We are situated on the height of land north of Wachusett Mountain. Our drainage and sewerage are natural, and we have no trouble at all from those imperfections found in lower towns.

Summary of Survey.

It is evident that there is not marked offensiveness in many places. In fact, a single woolen mill, discharging its refuse into the River Aire in England, employs nearly three-fourths as many operatives as the whole of the manufactories in the Nashua Basin in Massachusetts, and uses, annually, 320,000 pounds of logwood and similar dye wares; 15,000 pounds of chloride of lime, ammonia, and oil of vitriol; 40 to 50 tons of Gallipoli oil; 700,000 pounds of soap; and 14,000 tons of coal. It would be within bounds, too, probably, to say that the sewage of less than 10,000 people is cast directly into the Nashua and its tributaries within the State; but in a few places the pollution is so great as to demand interference.

In Shirley and Townsend there is complaint of the obstruction of streams from sawdust accumulating in their beds, after having been thrown out from the mills, a difficulty most easily avoided.

The evils in the drainage of Sterling are purely of a local character.

The inhabitants of North Leominster have to shut their windows at times to keep out of their houses the vile odors from the brook, contaminated by a tannery in that village; but the population is sparse, and it is not positively known that any serious ill health has been caused.

In Leominster Centre, the only sewer of the town empties into a mill-pond, which catches, also, to some extent, the

insoluble refuse from the mills above it, and a nuisance is the natural result ; but it has not yet given rise to much serious complaint.

Nookagee Brook, in Fitchburg, is black and filthy, but not stinking. The stream has a rapid fall over a bed rocky in its upper part, and is, immediately on its junction with the main stream, diluted with so large a quantity of water as to lose, to a considerable degree, its unsightly appearance after flowing a half-mile. Through the city the river is rather dark and sometimes turbid, but not often really foul-smelling, as is shown also by chemical examination. Punch Brook, however, a shallow stream, hardly a couple of feet wide, as it passes through the more thickly inhabited part of Fitchburg, is defiled by the privies, water-closets, etc., on its banks, thus creating a nuisance with which it will be difficult to deal satisfactorily unless filth is kept entirely out of the stream ; for, during freshets, several hundred times as much water passes through it as in time of drought. The main sewer discharges lower still, but quite near the city. At present the amount of sewage is small ; at times it has hardly even any color. But if the whole refuse of the houses is ever discharged at this point, it is pretty sure to cause more or less complaint in the future.

In Clinton a serious source of offence is in Quilt Pond, in the very centre of the town, which is not only polluted by the refuse of the carpet mills and gas works, and by the sewage of the town itself, but is a veritable settling-tank, dammed by the mill of the yarn company below, and placed by nature in the bottom of a deep valley. Of course the inhabitants suffer from the stench, some having removed from the vicinity ; and the water is valueless to the yarn company except for power. Even for this latter purpose, its supply is so uncertain that steam is chiefly used. The evil has been greater, too, during the past summer, from the fact that the destruction of the carpet company's dam opened a new course for the stream below, so that now Quilt Pond has not even the benefit of the overflow of the dam to partially flush it. In this case there are several interests to consult and several parties to blame. The carpet company empty a large amount of vile stuff into the stream, and the town adds to the pollution by

their sewer and their surface-drainage; but both of these might, perhaps, pass off without causing a serious nuisance were they not caught and kept by the dam of the yarn company. It is easy to see where and how a simple remedy could be effected, but there will naturally be some question as to who shall bear the brunt of the cost.

Chemical Examinations.

The following tables give the results of the examinations by Prof. Nichols. In Table VI., the condition of the river is shown in Nos. 1 to 14, when it was at moderate height; in Nos. 15 to 29, at its lowest summer flow, and in Nos. 30 to 40, at low summer flow. Tables VIII. and IX. are compiled from Table VI. Prof. Nichols's notes are as follows. His methods of analysis were fully given on page 174 of the seventh report.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, }
November 3, 1876. }

Dr. CHARLES F. FOLSOM, *Sec'y of the State Board of Health.*

DEAR SIR:—I present, herewith, the report of the examination of the specimens of water from the Nashua River Basin received at several different times. Those included in Nos. 1 to 14, I assisted, myself, in collecting. The others were collected by yourself, and received by me in sealed demijohns, apparently in good order. With reference to the results of the chemical examination, I may say,—

No. 5 (Quilt Pond) was very foul. The water was covered with an oily scum. The large amount of ammonia is no doubt due in part to the gas works which drain into the pond, and is an underestimate of the amount in the water when collected, as the ammonia was continually escaping. In fact, exposure to the air during the process of filtering caused a considerable decrease in the amount of ammonia. In addition to the gas works residue, there was evidence of other contamination, of an animal character, of the nature of grease and soap, no doubt coming from the carpet factory.

No. 7 (Tannery Brook, North Leominster) was the foulest of the examples examined. It had an odor of sulphuretted hydrogen, and contained much animal matter. No. 8, taken lower down on the same brook, was not as bad as No. 7, and quite clear to the eye, but still was very foul, as the chemical examination shows.

With reference to the remaining waters [of Nos. 1 to 14], it may

be said, that, owing to recent rain, the river above the Lancaster Mills, as well as below, appeared somewhat turbid; the amount of suspended matter was, however, very slight, and in a small quantity of the water hardly perceptible. Therefore, the distinction between "filtered" and "unfiltered" has no significance, as far as the "solid residue" is concerned, in the case of Nos. 1-4, 6, 9-11, 13, 14. No. 12 was considerably polluted, as was evident from its appearance and from the chemical examination, and the river was in scarcely better condition below Fitchburg (No. 13). Further down on the stream, however, there was a manifest improvement (No. 14).

Of the waters received September 14-16 (Nos. 15-29), no one had sufficient suspended matter to make its determination of any moment. They were all slightly colored, but not to a marked degree.

Of the waters received October 10, No. 31 was quite foul. The water was quite turbid, and, even after filtration through paper, was somewhat opalescent. The suspended matter submitted to microscopical examination showed, besides some particles of mineral matter and cotton and linen fibres (due, I presume, to paper mills above), a considerable number of filamentous algæ of the genus *Leptothrix*, the growth of which was no doubt induced by the decaying vegetable matter. The water was strongly alkaline, and contained a marked amount of sulphate of lime.

Nos. 32, 33, and 34 were similar to No. 31, although much less foul and containing less matter in suspension; No. 34 having, in fact, almost none. No. 35 was quite different from the others, as appears plainly in the table. No. 36 was very foul, and evidently, judging from the odor and from chemical examination, received the drainage from gas works. The water smelt strongly of coal-tar; it was very alkaline, and contained so much ammonia that it fumed when brought into the neighborhood of chlorhydric or nitric acid. A part of this ammonia escapes as free ammonia or carbonate during the evaporation. The remainder is driven off as ammonium salts when the residue is burned, and this accounts for the large amount of "Organic and Volatile Matter." The water contained, also, a trace of sulphuretted hydrogen (or rather of sulphide of ammonium).

Of the waters received October 31, Nos. 39 and 40 were clear, and but slightly colored. Nos. 37 and 38 were turbid, had a bad odor, and showed evident signs of refuse matter. No. 37 resembles other specimens from the same locality. No. 38 is, in fact, dilute sewage.

With reference to the acidity or alkalinity, I did not observe anything of note except in the foul waters noted, where the alkaline

reaction was very strong. I did not observe any case where there was acidity (except that due to the carbonic acid in solution). I think it very seldom, unless near to chemical works, that we should be at all likely to find an acid reaction, although in the Taunton Valley we did once find it so below some iron works.

In reply to your question concerning the significance of chemical examinations, I would say that it has always been felt that the most important point in the examination of a water is to determine as far as possible the nature and amount of the organic matter present. One of the oldest methods is to determine the *loss on ignition*. The solid residue left by evaporation is heated to destroy the organic matter, and the loss noted. If a water contains little carbonate of lime and only a small amount of nitrates and chlorides, this determination is not without value, and it is quite universally the custom in this country to make it and to tabulate the result as "organic and volatile matter." I have included these results in my tables. Conscious of the defects, and, in some cases, the absolute worthlessness of this determination, chemists have tried to devise other means of reaching an idea of the organic matter present. One which has been for a long time in use is to oxidize the organic matter by means of permanganate of potash, and to tabulate the amount of oxygen thus required. Some German chemists are in the habit of multiplying the amount of oxygen by five, and calling the result "organischer Substanz." This is entirely empirical, and in peaty waters absolutely inapplicable, and it appears better, in all cases, to state simply the amount of oxygen. The truth is, we know very little of the nature of the organic matter in natural water, and it is impossible by any means to state the exact *amount*; and if it were possible, we should still be in the dark as to the kind,—a small amount of one kind being of more significance than a large amount of another kind. Feeling, however, that it is to the *nitrogenous* organic matter that the most importance attaches, Frankland burns the residue of evaporation with the idea of determining the amount of ("organic") *nitrogen* and *carbon*, and the relative proportion in which they exist in the organic matter present. While the method is much the most troublesome and difficult of those in common use, it is a question whether the results are proportionately valuable, as they are, after all, even if perfectly accurate, like all other determinations of the organic matter, *simply comparative, and having no fixed and absolute significance*.

Most bodies containing nitrogen, if heated with a strongly alkaline solution of permanganate of potash, give off a certain amount of their nitrogen as ammonia. This amount is constant for any one substance, but different organic substances disengage a different

amount of ammonia. The ammonia obtained by this treatment is called "*albuminoid ammonia*," because the nitrogenous bodies from which it is derived are regarded as being in some sense of the nature of albumin.

Natural waters vary, of course, in the amount of organic matter they contain; a river like the Merrimac and one like the Taunton being very different, and to use the determination as an index of pollution we must know the character of the water. A well-water should give almost none, while a peaty water would give considerable, as peat contains considerable nitrogen in combinations somewhat readily destroyed. It follows that while the results of any one chemist are comparable among themselves, they cannot be compared exactly with those of some one working by different methods. Other determinations have been made of English waters, although all the analyses made by the last River Pollution Commission have been made by Frankland's methods.

Yours respectfully,

WM. RIPLEY NICHOLS.

TABLE VI.—*Examination of Waters of Nashua River Basin.*

[Results expressed in Parts per 100,000.]

Number.	Date of Collection.	LOCALITY ON MAP.	Date Received.	UNFILTERED WATER.					FILTERED WATER.				
				Ammonia.	"Albuminoid Am- monia."	Solid Residue.			Ammonia.	"Albuminoid Am- monia."	Solid Residue.		
						Inorganic.	Organic and Volatile.	Total at 212° Fahrenheit.			Inorganic.	Organic and Volatile.	Total at 212° Fahrenheit.
1	Aug. 3, .	h.,	Aug. 4, .	0.0088	0.0179	2.72	2.00	4.72	0.0088	0.0179	2.72	1.80	4.52
2	3, .	g.,	4, .	0.0080	0.0173	2.44	1.72	4.16	0.0080	0.0173	-	-	-
3	3, .	g.,	4, .	0.0067	0.0168	3.16	1.84	5.00	0.0067	0.0160	-	-	-
4	3, .	f.,	4, .	-	-	-	-	-	0.0064	0.0195	3.00	1.92	4.92
5	3, .	l.,	4, .	0.1988	0.2100	18.36	7.68	26.04	0.1284	0.0832	18.40	4.80	23.20
6	3, .	k.,	4, .	-	-	-	-	-	0.0069	0.0157	2.08	1.56	3.64
7	3, .	p.,	4, .	1.4700	0.2500	84.00	10.20	94.20	-	-	-	-	-
8	3, .	o.,	4, .	0.1780	0.0180	49.32	2.52	51.84	-	-	-	-	-
9	3, .	r.,	4, .	0.0067	0.0240	2.32	1.60	3.92	0.0059	0.0115	-	-	-
10	3, .	n.,	4, .	0.0096	0.0264	2.28	1.92	4.20	0.0096	0.0160	-	-	-
11	4, .	w.,	5, .	0.0085	0.0179	2.28	1.60	3.88	0.0085	0.0168	2.20	1.60	3.80
12	4, .	g.,	5, .	0.0080	0.0419	6.96	3.88	10.84	0.0083	0.0243	5.52	3.20	8.72
13	4, .	t.,	5, .	0.0181	0.0307	7.30	2.80	10.10	0.0181	0.0304	-	-	-
14	4, .	v.,	5, .	0.0184	0.0259	5.17	2.29	7.46	0.0184	0.0259	4.64	2.56	7.20
15	Sept. 13, .	g.,	Sept. 14, .	0.0005	0.0165	-	-	-	0.0005	0.0107	2.80	1.40	4.20
16	13, .	e.,	14, .	0.0056	0.0173	-	-	-	0.0056	0.0168	5.48	1.68	7.16
17	13, .	E.,	14, .	0.0019	0.0168	-	-	-	0.0019	0.0112	3.76	1.72	5.48
18	13, .	d.,	14, .	0.0061	0.0160	-	-	-	0.0061	0.0133	2.88	1.00	3.88
19	13, .	m.,	14, .	0.0093	0.0162	-	-	-	0.0160	0.0176	6.28	2.16	8.44
20	13, .	e',	14, .	0.0053	0.0157	-	-	-	0.0093	0.0162	5.08	1.96	7.04
21	14, .	c',	14, .	0.0005	0.0123	-	-	-	0.0053	0.0144	2.20	1.80	4.00
22	14, .	C.,	14, .	0.0005	0.0141	-	-	-	0.0005	0.0112	3.56	1.28	4.84
23	14, .	C.,	14, .	0.0059	0.0141	-	-	-	0.0059	0.0141	3.52	1.68	5.20
24	14, .	B.,	15, .	0.0155	0.0307	-	-	-	0.0155	0.0272	5.92	2.20	8.12

TABLE VII.—*Appearance and Locality of Samples in the previous Table.*

Number.	Appearance.	Locality.
1	Clean, . . .	Clinton, above Lancaster mills.
2	Dark, but not foul,	Clinton, below Lancaster mills, at first railroad bridge, left side of stream.
3	Dark, but not foul,	Clinton, same as No. 2, at right side of stream.
4	Clean, . . .	Clinton, below comb factory.
5	Foul and stinking,	Clinton, Quilt Pond in the centre of the town, into which the carpet mills and gas works drain.
6	Nearly clear, . .	Clinton, mill pond above carpet mills.
7	Very foul, . . .	N. Leominster Brook, one-quarter mile below tannery.
8	Foul, . . .	Same as No. 7, one-half mile lower, where the brook enters the river.
9	Clear, . . .	Leominster, above upper comb factory.
10	Clear, . . .	Leominster, below all factories.
11	Clear, . . .	Fitchburg, Nookagee Brook, above upper woolen mill.
12	Almost clear, .	W. Fitchburg, below junction of Nookagee Brook and river.
13	Dark and turbid, .	Fitchburg, at railroad bridge, above sewer mouth.
14	Clear, . . .	South Fitchburg, below scythe shop.
15	Dark and turbid, .	Middle of railroad bridge, below Lancaster mills.
16	Clear, . . .	North Branch Nashua River, one-quarter mile above junction.
17	Clean, . . .	Nashua River, twenty rods below junction of North and South branches.
18	Clean, . . .	South Branch Nashua River, one-quarter mile above junction.
19	Discolored, . .	North Branch, just below shoe shank manufactory.
20	Clean, . . .	North Branch, ten rods below cotton mills.
21	Clear, . . .	Catecunamug Brook, one-quarter mile below all mills.
22	Clear, . . .	Nashua, just below junc'n with Squanacook, left side.
23	Clear, . . .	Nashua, just below junc'n with Squanacook, right side.
24	Nearly clear, . .	Nashua, just below Pepperell.
25	Clean, . . .	Nissitisset, just below Pepperell.
26	Clean, . . .	Nashua, one-quarter mile before State line.
27	Dark and peaty, .	Nissitisset, one-half mile below State line.
28	Not bad, . . .	Nashua, one-eighth mile before entering Merrimac, below
29	Not bad, . . .	all mills and gas works, one-eighth mile below latter.
30	Dirty, but not foul,	N. Branch Nashua River, just above Nookagee Brook.
31	Filthy, . . .	Nookagee Brook, just above Nashua River.
32	Somewhat turbid, .	Below junction of 30 and 31, same as 12.
33	Less turbid, . .	Fitchburg bridge, at upper end of city proper.
34	Dark, . . .	Railroad bridge, at lower end of city, same as 13.
35	Clear, . . .	Baker's Brook.
36	Very foul, . . .	Drainage of gas works, a few feet from outlet into small pond.
37	Foul and turbid, .	Fitchburg, Nashua River below Nookagee Brook, same as 12 and 32.
38	Very foul, . . .	Fitchburg, Punch Brook.
39	Very clear, . . .	West Fitchburg, Nookagee Brook, above all dams.
40	Very clear, . . .	West Fitchburg, North Branch, above all dams.

The samples taken below Nashua were not as foul in appearance as is said to be sometimes the case; but, of course, this differs from time to time. In Fitchburg, for instance, three samples (12, 32, and 37) taken from the same place, but at different times, are described as "almost clear," "somewhat turbid," and "foul and turbid."

Table VIII. (see p. 56) gives a general sketch of the river from its sources to its final discharge into the Merrimac River, being about thirty-two miles from the latter point to the junction of the north and south branches; and thence eighteen miles to the point z' in Fitchburg, and thirteen to Still River in Boylston.

In Table IX., a few of the worst specimens have been placed together for ready comparison, representing the condition of the water in those few places where it was found excessively bad. The drainage from the gas works at Fitchburg, although very foul, passes only indirectly into the river, much of it only after percolating through sand and gravel. Most of the ammonia, too, probably escapes into the open air.

TABLE VIII.—*Examination of Nashua River.*

[Results expressed in Parts per 100,000.]

Number.	Locality on Map.	CONDITION.	Ammonia.	"Albuminoid." Ammonia.	SOLID RESIDUE.			Chloride.	Appearance.	Remarks.
					Inorganic.	Organic and Volatile.	Total at 212° F.			
1	Nashua Riv., S. Br.	Unfiltered, .	0.0088	0.0179	2.72	2.00	4.72	0.16	-	Clinton from the raceway above Lancaster Mills.
		Filtered, .	0.0088	0.0179	2.72	1.80	4.52	-	Clear.	
6		Unfiltered, .	-	-	-	-	-	0.24	Clear.	Clinton from the carpet company's pond.
		Filtered, .	0.0069	0.0157	2.08	1.56	3.64	-	-	S. Br. of Nashua River, below all mills.
18		Unfiltered, .	0.0061	0.0160	2.88	1.00	3.88	0.24	Clean.	
		Filtered, .	0.0061	0.0133	-	-	-	-	-	
40		Unfiltered, .	0.0037	0.0117	1.64	1.20	2.84	0.15	Clear and sparkling.	North Branch of Nashua River above the last dam in West Fitchburg.
		Filtered, .	0.0037	0.0117	1.60	1.04	2.64	-	-	
39		Unfiltered, .	0.0021	0.0088	1.68	0.84	2.52	0.22	Clear and sparkling.	Nookagee Brook, West Fitchburg, above all mills.
		Filtered, .	0.0021	0.0085	1.48	0.88	2.36	-	-	
9	Nashua River, North Branch.	Unfiltered, .	0.0067	0.0240	2.32	1.60	3.92	-	-	Headwaters, Leominster.
		Filtered, .	0.0059	0.0115	-	-	-	-	Clear.	
		Unfiltered, .	0.0110	0.0284	7.30	2.80	10.10	0.59	Dark and turbid.	Fitchburg, below city proper.
		Filtered, .	0.0110	0.0280	5.12	2.32	7.44	-	-	
Average of 13 and 34.										
16	Nashua River, North Branch.	Unfiltered, .	0.0056	0.0165	2.80	1.40	4.20	0.24	Clean.	North Branch of Nashua River, below all mills.
		Filtered, .	0.0056	0.0107	-	-	-	-	-	

Nashua River.											
17	E	Unfiltered,	0.0019	0.0168	3.76	1.72	5.48	0.50	-	Below junction of N. and S. branches.	
Average of 22 and 23.	C	Filtered,	0.0019	0.0112	-	-	-	-	Clean.	Below junction with Squanacook River.	
		Unfiltered,	0.0032	0.0132	3.54	1.48	5.02	0.39	-		
24	B	Filtered,	0.0032	0.0127	-	-	-	-	Clean.	Below Pepperell.	
26	A	Unfiltered,	0.0155	0.0307	5.92	2.20	8.12	0.38	Nearly		
		Filtered,	0.0155	0.0272	-	-	-	-	clear.	State line.	
Average of 28 and 29.	AA	Unfiltered,	0.0056	0.0149	2.84	2.04	4.88	0.40	-		
		Filtered,	0.0056	0.0136	-	-	-	-	Clean.	Below Nashua, N. H.	
		Unfiltered,	0.0144	0.0179	3.04	1.84	4.88	0.41	Not bad.		
		Filtered,	0.0144	0.0164	-	-	-	-	-		

TABLE IX.—*Examination of Nashua River Basin.*
[Results expressed in Parts per 100,000.]

Number.	Locality on Map.	CONDITION.	Ammonia.	"Albuminoid Ammonia."	SOLID RESIDUE.			Chlorine.	Appearance.	Locality.
					Inorganic.	Organic and Volatile.	Total at 212° F.			
5	i.	Unfiltered, . . .	0.1988	0.2100	18.36	7.68	26.04	2.20	Very foul and stinking.	Quilt Pond, below carpet mill and gas works, at Clinton.
		Filtered, . . .	0.1284	0.0832	18.40	4.80	23.20	-		
7	p.	Unfiltered, . . .	1.4700	0.2500	84.00	10.20	94.20	39.40	Very foul.	One-quarter of a mile below tannery at North Leominster.
8	o.	Unfiltered, . . .	0.1780	0.0180	49.32	2.52	51.84	23.10	Foul.	Same as 7, one-half mile lower.
31	y.	Unfiltered, . . .	0.0053	0.0323	10.44	6.12	16.56	1.28	Filthy.	Nookagee Brook, Fitchburg.
		Filtered, . . .	0.0053	0.0315	8.56	4.32	12.88	-	-	
36	near u.	Unfiltered, . . .	15.2000	0.0797	8.44	8.48	16.92	2.76	Foul.	Drainage of gas works into stagnant pond, Fitchburg.
		Filtered, . . .	13.6000	0.0797	-	-	-	-	-	
38	v.	Unfiltered, . . .	0.5440	0.1493	10.84	6.52	17.36	2.21	Foul.	Punch Brook in Fitchburg.
		Filtered, . . .	0.5440	0.0795	9.48	4.32	13.80	-	-	

The Purification of Polluted Streams.

From the foregoing tables, it is seen that there is a decided, but not excessive, increase in the amount of pollution, as the outlet is approached. At the same time, it is evident that the processes of purification go on rapidly. It should be remembered, however, that the worst and most dangerous source of pollution to rivers, human excrement, is found in the Nashua at the present time only in very small quantities, as compared with the volume of the river.

The conclusion of the Rivers Pollution Commission of England, based chiefly upon laboratory experiments, but also partly on chemical examination of small streams flowing through densely populated regions, and therefore constantly subject to polluting substances, and so long accepted as authoritative, "that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation," is certainly not fully borne out, so far as the Nashua River is considered, by the results which we have got. Our deductions, too, are confirmed by the results of many examinations by M. Dumas of the River Seine, beginning above the city of Paris and extending to Rouen some one hundred miles lower. The French method of analysis differs from that in common use in England and this country, and consists chiefly in determining the amount of free oxygen present. Of course, the oxygen would be rapidly used up by any putrescible matter coming in contact with it, and, therefore, the more oxygen present in any given sample of water, the purer must that water be.

TABLE X.—*Showing the number of centiliters of free oxygen in a liter of water from different localities in the River Seine.*

LOCALITY.	Oxygen present.
Corbeil (above Paris),	9.
Pont d'Ivry (near the upper border of the city),	8.
Pont de la Tournelle (about the middle of the city),	8.
Auteuil (suburb below city and above outlets of main sewers),	6.
Asnières (outlet of upper main intercepting sewer),	4.6
St. Denis (outlet of lower main intercepting sewer),	2.
Epinay (below all sewers),	1.
Poissy (about 17 miles below Epinay),	6.
Vernon (about 27 miles below Poissy),	9.5
Rouen (about 35 miles below Vernon),	10.5

At the International Sanitary Congress at Brussels in 1876, Mons. A. Gérardin of Paris, inspector of establishments injurious to health, read a paper* embodying the results of three thousand chemical examinations of water taken from different parts of the river Seine, and made under directions from the prefect of the police.

Examinations of eighty specimens gave the following results : At the bridge of Asnières, just below the outlet of the main intercepting sewer of Paris, there was no complaint of bad odor ; fish caught there were readily eaten by cats ; there were to each liter of water 6.88 cl of oxygen and 275 milligrams of solid residue, of which 61 milligrams were organic matter. Four or five kilometers lower, at the bridge of St. Denis, and just above the smaller intercepting sewer, so that there could not have been much additional pollution between the two points, there were loud complaints of stink ; cats refused to eat the fish caught there ; and there were to each liter of water 3.37 cl of oxygen and 280 milligrams of solid residue, of which 61 milligrams were organic matter. Here, in the two places, the organic matter was the same, so far as chemistry could detect any difference, but there evidently was the difference between nearly fresh sewage and oxidized or putrefied sewage. The relative quantities of oxygen in the two places, by subsequent examinations, were respectively 4.28 cl and 1.07 cl to the liter.

The foulness of the river reached its maximum 23 kilometers below the sewer-outlet, and then became gradually less, until, at a distance of 65 kilometers more, it had regained the degree of purity which it had before reaching Paris.

Gérardin showed that the water of the Seine was more foul near its bed than at the surface, the opposite of the case in unpolluted rivers, and attributable to the sewage deposits. The influence of the wind, temperature, barometric pressure of the atmosphere and height of the river were also shown to be considerable.

Fish were found to die in the Seine when the water contained not over 1.5 cl of oxygen to the liter ; and this happened in 1874 over a distance of 26 kilometers.

* Annales d'Hygiène Publique et de Médecine Légale, Jan., 1877, pp. 87, *et seq.*

A novel expedient is suggested for the purification of the river, and consists in having long open canals through which the sewage would flow, and in which it would be exposed to the free action of the air. It was proposed, too, to plant in these canals vigorous aquatic plants, beginning with the *Arundo Phragmites*, which grows even in the most filthy places, and placing after it, in order, the *Sparganium simplex*, the *Myriophyllum*, the *Chara*, the false cress, and, last, the water-cress, upon which are found the animalcules characteristic of pure water.

Pollution of the Nashua.

It is readily seen, that, except at the head-waters, the Nashua River is so polluted throughout its whole length that it would be unwise to use any part of it for a domestic water-supply. It is not at any place in Massachusetts, except occasionally at Fitchburg, offensive to smell, although some of its tributaries (at Clinton, Fitchburg, Leominster, and Shirley) are in a filthy condition. In fact, with the selectmen of every town in our State having the power to act as a board of health, although that power has seldom been exercised as effectively as is desirable, it would not be easy for any of our rivers to become so offensively polluted as has been not uncommon in England; for instance, where, according to the royal commissioners, the *Aire* and the *Calder* and their tributaries "are abused by passing into them hundreds of thousands of tons per annum of ashes, slag, and cinders from steam-boiler furnaces, iron works, and domestic fires; by their being made the receptacles, to a vast extent, of broken pottery and worn-out utensils of metal, refuse bricks from brick-yards and old buildings, earth, stone and clay from quarries and excavations, road-scrappings, street-sweepings, etc.; by spent dye-woods and other solids used in the treatment of worsteds and woolens; by hundreds of carcasses of animals, as dogs, cats, pigs, etc., which are allowed to float on the surface of the streams or to putrefy on the banks; and by the flowing in, to the amount of very many million gallons per day, of water poisoned, corrupted, and clogged by refuse from mines, chemical works, dyeing, scouring, and fulling worsted and

woolen stuffs, skin-cleaning and tanning, slaughter-house garbage, and the sewage of houses and towns."

How far the present condition of the Nashua River, not considering the obstructions from dams, has to do with the disappearance of salmon, trout, and pickerel, it would be difficult to say: that they have been driven from many of the smaller streams, in part, at least, by the offensive matters discharged into them, there can be hardly a doubt; but the same causes have also been at work here which have driven the game from our woods,—that is, both have often been exterminated. Last year, it was reported to the Board of Health that fish had been destroyed in the river, two miles below Clinton, by the mill-refuse from that town; and in Quilt Pond even the eels have been killed. But a few rods below the outlet for the waste of the Lancaster mills, fishermen may often be seen, when the water is not low, having "quite good luck" in catching the more hardy varieties of fish. Of course, salmon cannot be expected to thrive even in a river of absolutely pure water, if it is thoroughly obstructed by high dams.

The attempt which is now making to stock the river near Lancaster village with young salmon and bass, will be followed with great interest. It is feared that the trades-pollution will destroy many, although the fact has not been proved by the experience of the past summer.

Except at Fitchburg, and just below the mills in a few other places, where the river is somewhat turbid, the *Nashua* has generally the appearance of an unpolluted stream, until it reaches the city of Nashua, N. H. To render it actually pure and free from contamination throughout, would be indeed a difficult task; and it is doubtful whether the amount of good attained would compensate for the necessary cost and inconvenience, especially as there are other sources from which water for domestic use may be got.

Some Pollution Unavoidable.

In this connection, the testimony* of Mr. Robert Rawlinson, C. E., C. B., is of especial interest, and probably expresses the opinion of the Local Government Board of

* Before the Conference on the Health and Sewage of Towns, held by the Society of Arts, in London, May 9, 10, and 11, 1876.

England, reached after many years of study and experience in the matter.

“The question of dealing with sewage ought not at the outset to be one of profit to the town, but of getting rid of that which was injurious to human health in the cheapest and readiest way. There were many places in Lancashire and Yorkshire where irrigation was impracticable for two reasons: one, the difficulty of obtaining land; and another, the great objection to depriving the district of its water. The manufacturing districts were so thickly planted that they must have water, dirty or clean; and there were many purposes for which dirty water could very well be used, though they would much rather have clean. How the rivers were to be cleansed was the great problem to be solved, as it was evident that the manufacturing industries could not be very much extended if the present rate of pollution went on. This pollution took place in various ways, and . . . proper regulations might very largely reduce the present evils. He should certainly tremble, however, for the trade of this country, if at first rigid chemical standards were set up and enforced, simply because it would be absolutely impossible. He held that nothing could be more injurious for a state than to enact a law which could not be obeyed. Certain restrictions might, however, be very stringent, if they were confined to special things.”

Until we have better means of disposal of our refuse than at present, some of our rivers must be used, more or less, to scavenge the country; and the resulting evil, if reasonable care is used, must be very small as compared with the methods by which filth fails to be promptly and efficiently removed. Sewage-irrigation is not profitable, and, if on a large scale, is costly, while small towns, generally, cannot afford to have well-constructed sewerage-systems. The various methods of filtration or precipitation do not *purify* sewage. It is easy, however, to prevent any serious pollution which may render such streams unsightly, offensive, or unfit for ordinary purposes; and it is not necessary, in their case, that the water should be pure enough for men to drink. If it is fairly cleansed, that is as much as we can expect at present, however much we may desire something more.

Disposal of Sewage in the Nashua Basin.

The difficulties in dealing with large amounts of sewage, say of a town of ten thousand inhabitants, are at least as great, and the pecuniary loss undergone is fully as considerable, by the clarifying or chemical processes as by the purifying or irrigation method; while the former are *ipso facto* nuisances, if on a large scale, and the latter, if properly managed, do not cause bad odors. In towns, therefore, irrigation is, on all accounts, to be preferred. But with many of the mills the waste is concentrated, and either valuable in itself, or most of it is readily rendered insoluble, if not so already, and is easily separated from the water. For mills, then, unless the waste can be discharged into the town-sewers and, thus diluted, be *purified* by irrigation, the chemical processes are generally the most easily managed, and, if the works can be placed remote from dwellings, accomplish as great an amount of cleansing, with as little offence, as it is fair now in most cases to demand. Intermittent downward filtration may be used where such cleansing is insufficient.

In leather-board mills the desired object might be got at very moderate expense; in gas works, the expense of so doing may be nearly covered by saving the tar; in tanneries, a great outlay would not be required; in linen mills, the waste liquors from cleansing and bleaching would be too concentrated for use in irrigation, but they might be disposed of by intermittent downward filtration, or by precipitation; in cotton mills, the waste from bleaching and washing and dyeing could be precipitated and kept out of the rivers, although probably of not much value; the "boilings" from paper mills could probably be utilized with some pains, while the scourings from wool are very valuable and would be likely to more than repay the cost of collecting their precipitable parts. In England, much of the oil used before fulling is saved, and even finds a sale in this country. The poisonous chemicals used in dyeing are so valuable that they are economized as much as possible; the grosser dyes may be kept out of the streams by precipitation, but with some trouble. Of course the degree of concentration in all of these waste-liquids will

depend considerably upon the abundance or otherwise of the supply of water in each case.

Sewage-Clarification at Walpole.

In Walpole, at an establishment for washing and bleaching cotton-waste, the refuse was so highly offensive a few years ago, that the proprietor roughly prepared a cheap set of precipitating basins by simply throwing up a wall of earth, which retains the solid matter and grease. The effluent flows through a half-dozen rods of marsh, and, at its discharge into the brook, still looks somewhat turbid; but, twenty rods lower, and before entering the river, when visited, without any previous notice, October 19, 1876, there was nothing objectionable. This arrangement has been in existence four years, during which time complaints—which had been formerly frequent—ceased. There was no stink at the time of inspection, but it is said to be a source of offence in the immediate vicinity in hot weather, although no one lives near enough to be annoyed by it.

Propriety of Legislation.

As may be seen from the pages of the last report of the State Board of Health, no laws allowing injunctions and special actions by local authorities have been successful in rendering pure the streams of England; nor should we have reason to expect a better result in this country. This position is well illustrated by what actually occurred in Clinton in 1875. A petition was sent to the local board of health in regard to the nuisance in that town from the pond already referred to. After giving the matter their careful consideration, they replied in the following words: "As the power conferred by the statutes on the board of health is, in its application to this case, in their opinion, very doubtful, it is decided to take no farther action on the petition." What is required is evidently some general Act of the Legislature applying to the whole State and placing the necessary authority in some central board.

If such an Act were passed, the question would naturally arise, What constitutes pollution sufficient to call for interference, and what remedy shall be adopted? For it would be

manifestly absurd to say that present methods must be abandoned until some practicable substitute could be suggested. Of course no one system would be applicable in all cases alike. For instance, in a seaboard city like Boston, where the waste is enormous and the present nuisance great, any attempt to utilize or deodorize sewage must be attended with great pecuniary loss, and, on so great a scale, perhaps with otherwise unsatisfactory results, while it may be cast into the sea easiest and best. In Salem, evils of a similar character may be found, and the most practicable remedy would doubtless be similar. In Lynn, although on the sea, it will be extremely difficult, if possible, to find a suitable outlet for intercepting sewers. It is out of the question to discharge sewage on a beach, to be washed up on to the shore; it would be idle to attempt to dike and irrigate the flats near the city; a pumping-station discharging sewage into the Saugus River would probably be objected to by all those who frequent Revere Beach, while a nuisance would follow in Lynn itself, if any attempt were made to remove the precipitable parts of the sewage, by any of the chemical processes, near the city. What remains, then, but carrying the sewage inland, or to some of the distant marshes for irrigation, a costly if practicable method, or restricting the use of water-closets, at least their connection with sewers, and emptying vaults and cess-pools, by some of the odorless processes now in use in large cities and by systems of "dry removal"? The problem, certainly, is a difficult one, and is not likely to be solved in the best manner without careful consideration of the present and future wants of the city. In Natick, where the water-supply of our largest city is endangered, something should be done at once, and irrigation seems the only real remedy, as also in Worcester. In small villages with few or no sewers, probably nothing would be gained by compelling them to keep their drainage out of streams such as are not used now, or are not likely to be used in the future, as water-supplies. The same mill might be a serious nuisance on a small or sluggish stream, and of no consequence on a large or rapid river, especially if near the sea.

THE NASHUA RIVER BEYOND THE STATE LINE.

After leaving our State, the *Nashua* is polluted only by the waste of a city of 12,000 inhabitants in New Hampshire. On the Nissitisset, in that State, the pollution is quite small. In Nashua, there are on the river two large cotton mills, two small dye-houses, one card and glazed-paper mill, the gas works, and several other mills of various kinds, which can hardly be considered as sources of contamination to the water.

The upper cotton mill—the Nashua—employs 1,100 hands, has 75,000 spindles, and, with a fall of 34 feet, uses the water for power and for washing the cloth. The trades-pollution above does not seriously affect this company, as they are some eight miles below the nearest mills above them. No dyeing is done; in the other processes, lime, sulphuric acid (the two probably nearly neutralizing each other in the bleaching), and soap are used. The amount of stock converted into cloth yearly is, in round numbers, 5,000,000 pounds.

The Jackson Company, perhaps a half-mile lower on the river, use only clean cotton, and do no dyeing or bleaching. They have a fall of 18 feet, employ 450 hands, with 22,000 spindles, and, as the river serves only for power for them, they are not seriously affected by the dye works, paper mill, etc., above them. The board of health of Nashua, in kindly replying to our circular, state that the pollution of the river consists, in that city, of lime, dyestuffs, excrement, street-washings, etc., and the poisonous chemicals from the card and glazed-paper mill.* They also state, "Below the mills, on the Nashua River, the water is almost black, is unfit to drink, and in very hot weather is sometimes odorous, but not to the extent of causing general complaint." A large portion of the town sewage finds its way into the river, and, quite below the settled parts, the gas works pour a considerable amount of offensive matter into its current.

* Four tons of paper are used per day; the chemicals used are Paris green, blue vitriol, acetate of lead, arsenious acid, bichromate of potash, carbonate of baryta, sal-soda, sulphuric acid, muriatic acid, clay, magenta, and other aniline colors, coralline, and various dyewoods.

POLLUTION OF THE MERRIMAC.

This amount of filth passes into the Merrimac, a river draining a large part of the State of New Hampshire, including the cities of Concord and Manchester; and we might expect to get full evidence of contamination at Lowell and Lawrence. And yet the numerous analyses which have been made in previous years show no very striking amount, although the mere fact of this sewer-character of the river, especially with the knowledge that it is likely to increase rather than diminish, should render its use allowable as drinking-water only on the ground of necessity. It is now used for that purpose to some extent in Lowell, Lawrence, and Haverhill.

It should be remembered in this connection, however, that it is *quantity*, and not *quality*, of impurity which we detect by chemical analysis; and that it is the general opinion of authorities, that water containing an amount of impurity so small as to escape the tests of the chemist altogether, may possess such virulent character, from containing the contagium of specific diseases, as to be unfit for drinking.

To purify the Merrimac River, so that it would, without treatment, be desirable as a domestic water-supply, would require the vigorous coöperation of the authorities of two States in an amount of compulsory legislation which we could hardly now expect to see enforced. The cities just named, however, must get their water-supplies from the Merrimac, in part at least, or else incur enormous expense; and if the water were carefully filtered, as it is not now, before being used, we should not be justified in condemning it, however much we should prefer a supply that had not been so exposed to contamination, especially in view of the fact that London, which has the lowest death-rate of all the large cities of the world, gets sixteen-seventeenths of its water, but filtered, from rivers much more polluted than the Merrimac.

In view of the above facts, the importance is readily seen of preventing any farther fouling of the Nashua and Merrimac rivers, although it must be acknowledged that, so far as chemical analysis goes, the latter compares now very favora-

bly with waters of standard purity,* as may be seen by the following table (page 70), calculated from the examinations by Professor Nichols in the Fifth Report of the State Board of Health, and by Professor Wood in the Report upon the Sanitary Qualities of the Sudbury, Mystic, Shawshine, and Charles River Waters :—

* It is said that typhoid fever, which was formerly more prevalent in Lawrence, has become comparatively rare since the introduction of the water from the Merrimac River. This point has not yet been specially investigated, however, by the writer.

TABLE XI.—*The Merrimac and other Waters.*
[Results expressed in Parts per 100,000.]

	Ammonia.	"Albuminoid Am- monia."	Solid Residue.			Chloride.	
			Inorganic.	Organic and Volatile.	Total at 212 deg. Fahr.		
Lowell, above dam, Merrimac River,	0.0047	0.0114	2.21	1.75	3.96	0.14	Average of 9 samples.
Lawrence, above dam, Merrimac River,	0.0044	0.0102	2.41	1.69	4.09	0.19	Average of 12 samples.
Water-supply of Boston, Cochituate Lake,	0.0035	0.0113	2.84	2.06	4.90	0.22	Average of 7 samples.
Water-supply of Boston, Sudbury River,	0.0022	0.0180	3.95	2.75	6.70	0.22	Average of 4 samples.
Head-waters of the Nashua River (Clinton),	0.0088	0.0179	2.72	2.00	4.72	0.16	-
Head-waters of the Nashua River (West Fitchburg),	0.0021	0.0088	1.68	0.94	2.62	0.22	-

Ruralvill



Asnybar

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EFFECT OF FARMING, PERCOLATION, ETC.

The influence of high cultivation of farm-lands in polluting streams running through them, has been often referred to, and many experiments bearing on the question have been made during the last quarter of a century by Dalton, Dickinson, Frankland, Lawes and Gilbert, Greaves, and Voelcker in England; Gasparin, and Marié-Davy in France; Maurice, and Risler in Switzerland; and Ebermayer, and Woldrich in Austria, who all come to pretty much the same conclusions as to evaporation and percolation as compared with rainfall.

Mr. Charles Greaves, C. E., Consulting Engineer of the East London Water Works, has recently published a *résumé* of experiments* very carefully conducted by him during the past twenty-two years, from which the general results observed, are: "The magnitude of percolation through sand at all times; the smallness of percolation through earth on the whole; the consequent magnitude of evaporation; the entire absence of percolation in warm summer weather; the excess of evaporation from ground over evaporation from a surface of water in winter, and from a surface of water over evaporation from ground in summer," etc. During the last fourteen years only were all the facts given in the following table observed, and the averages for that time are as follows:—

TABLE XII.

RESULTS FOR FOURTEEN YEARS.						Inches.
Average annual rainfall,	.	.	.	.	.	25.721
percolation through ground,	.	.	.	.	.	7.582
evaporation from ground,	.	.	.	.	.	18.138
evaporation from water,	.	.	.	.	.	20.613
evaporation from sand,	.	.	.	.	.	4.313
excess of rain over evaporation from water,	.	.	.	.	.	5.108
excess of evaporation from water over evaporation from ground,	.	.	.	.	.	2.475

In making these experiments, the "ground" used was put in a slate box of one cubic yard capacity, and was made as

* These, the most complete in existence, may be found in the forty-fourth volume of the Minutes of the Proceedings of the Institution of Civil Engineers, London, 1876.

nearly as possible like ordinary ground, but not exactly so. The interesting point with reference to the pollution of streams is the small amount of rainfall which actually passes through the soil, and the entire absence of percolation, in summer. If lands are heavily manured in a fall followed by a wet winter, of course the percolation, and consequent escape into streams, would be very much greater than if the winter were dry; in the former case, spring is the better time for manuring land, and, in the latter, autumn. Dr. Gilbert thinks that "when the matters had passed through a considerable depth of soil, there was not so much danger from ordinary agriculture as was sometimes supposed." He also gives the results of experiments at Rothamsted, England,* extending from 1866 to 1873, in which the drains were opened from time to time at different periods of the year, and the water analyzed either by Professor Frankland or Dr. Voelcker. Wheat had been grown on the land since 1844. The average of their results is thus stated, the depth of the drains being between three and four feet.

TABLE XIII.

ONE ACRE OF LAND TREATED WITH—	Number of Experiments.	Nitrogen as Nitrates and Nitrites per 100,000 parts of drainage-water (average).
No manure for years,	11	0.353
Fourteen tons barn manure each year, .	6	1.264
Mineral manure,	11	0.428
Mineral manure and ammonia salts (41 lbs. nitrogen),	11	0.823
Mineral manure and ammonia salts (82 lbs. nitrogen),	11	1.439
Mineral manure and ammonia salts (123 lbs. nitrogen),	11	1.815
Mineral manure and nitrate of soda (82 lbs. nitrogen),	10	1.437

Such high manuring is not common in ordinary farming; and where there are no drains, the filtration would be slower, and the effluent water would become nearly pure. In sand or gravel, too, the result would be much less satisfactory than in denser soils.

These examinations are given in full in the final report of

* Op. cit.

the English Rivers Pollution Commission, who conclude from them that "water collected from the surface, or the drains of cultivated land, is always more or less polluted with the organic matter of manure, even after subsidence in lakes or reservoirs. Such *polluted surface* or *drainage water* is not of good quality for domestic purposes; but it may be used with less risk to health than polluted shallow-well water, if human excrementitious matters do not form part of the manure applied to the land."

It is well known that all river-water contains a variable amount of soluble matter and of substances in suspension, valuable as a fertilizer; and in some river-valleys this is so great that no other manure is needed. Further experiments on these points are evidently desirable.

LEGISLATION IN ENGLAND.

An Act passed in England during the past year is of sufficient interest in connection with this subject to be given entire. It has not fully met with the approval of all the sanitarians; but more stringent bills have failed to go through both houses of Parliament; and Mr. Selater-Booth, President of the Local Government Board, the office where the bill was drawn up, was fully convinced that the people of that country are not ready for any more advanced measures now. He thought it better to be satisfied with a moderate gain that is practicable, and which will make a vast improvement in the rivers, rather than leave the evil in its present magnitude until all the requirements of sanitary law could be fulfilled in a better Act.

In Massachusetts, we are chiefly interested in *preventing* the contamination of our streams, although in Boston, Brookline, Cambridge, Clinton, Fall River, Fitchburg, Haverhill, Lynn, Natick, Salem, Somerville, Woburn, and Worcester evils of some magnitude are already staring us in the face. On a smaller scale, there are local nuisances in many parts of the State.

[39 and 40 Vict. chap. 75.]

AN ACT for making further Provision for the Prevention of the Pollution of Rivers.

[15th August, 1876.]

Whereas it is expedient to make further provision for the prevention of the pollution of rivers, and in particular to prevent the establishment of new sources of pollution:

Be it therefore enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. This Act may be cited for all purposes as the Rivers Pollution Prevention Act, 1876.

PART I.

Law as to Solid Matters.

2. Every person who puts, or causes to be put or to fall, or knowingly permits to be put or to fall or to be carried into any stream, so as either singly or in combination with other similar acts of the same or any other person to interfere with its due flow, or to pollute its waters, the solid refuse of any manufactory, manufacturing process or quarry, or any rubbish or cinders, or any other waste, or any putrid solid matter, shall be deemed to have committed an offence against this Act.

In proving interference with the due flow of any stream, or in proving the pollution of any stream, evidence may be given of repeated acts which together cause such interference or pollution, although each act taken by itself may not be sufficient for that purpose.

PART II.

Law as to Sewage Pollutions.

3. Every person who causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any solid or liquid sewage matter, shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act.

Where any sewage matter falls or flows or is carried into any stream along a channel used, constructed, or in process of construction at the date of the passing of this Act for the purpose of conveying such sewage matter, the person causing or knowingly permitting the sewage matter so to fall or flow or to be carried shall not be deemed to have committed an offence against this Act if he shows to the satisfaction of the court having cognizance of the case that he is using the best practicable and available means to render harmless the sewage matter so falling or flowing or carried into the stream.

Where the Local Government Board are satisfied after local inquiry that further time ought to be granted to any sanitary authority which at the date of the passing of this Act is discharging sewage matter into any stream, or permitting it to be so discharged, by any such channel as aforesaid, for the purpose of enabling such authority to adopt the best practicable and available means for rendering harmless such sewage matter, the Local Government Board may by order declare that this section shall not, so far as regards the discharge of such sewage matter by such channel, be in operation until the expiration of a period to be limited in the order.

Any order made under this section may be from time to time renewed by the Local Government Board, subject to such conditions, if any, as they may see fit.

A person other than a sanitary authority shall not be guilty of an offence under this section in respect to the passing of sewage matter into a stream along a drain communicating with any sewer belonging to or under the control of any sanitary authority, provided he has the sanction of the sanitary authority for so doing.

PART III.

Law as to Manufacturing and Mining Pollutions.

4. Every person who causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any poisonous, noxious, or polluting liquid proceeding from any factory or manufacturing process, shall (subject as in this Act mentioned) be deemed to have committed an offence against this Act.

Where any such poisonous, noxious, or polluting liquid as aforesaid falls or flows or is carried into any stream along a channel used, constructed, or in process of construction at the date of the passing of this Act, or any new channel constructed in substitution thereof, and having its outfall at the same spot, for the purpose of conveying such liquid, the person causing, or knowingly permitting the poisonous, noxious, or polluting liquid so to fall or flow or to be carried, shall not be deemed to have committed an offence against this Act if he shows to the satisfaction of the court having cognizance of the case that he is using the best practicable and reasonably available means to render harmless the poisonous, noxious, or polluting liquid so falling or flowing or carried into the stream.

5. Every person who causes to fall or flow, or knowingly permits to fall or flow, or to be carried into any stream, any solid matter from any mine in such quantities as to prejudicially interfere with its due flow, or any poisonous, noxious, or polluting solid or liquid matter proceeding from any mine, other than water in the same condition as that in which it has been drained or raised from such mine, shall be deemed to have committed an offence against this Act, unless in the case of poisonous, noxious, or polluting matter he shows to the satisfaction of the court having cognizance of the case that he is using the best practicable and reasonably available means to render harmless the poisonous, noxious, or polluting matter so falling or flowing or carried into the stream.

6. Unless and until Parliament otherwise provides, the following enactments shall take effect, proceedings shall not be taken against any person under this part of this Act save by a sanitary authority, nor shall any such proceedings be taken without the consent of the Local Government Board: Provided, always, that if the sanitary authority, on the application of any person interested alleging an offence to have been committed, shall refuse to take proceedings, or apply for the consent by this section provided, the person so interested may apply to the Local Government Board, and if that Board, on inquiry, is of opinion that the sanitary authority should take proceedings, they may direct the sanitary authority accordingly, who shall thereupon commence proceedings.

The said Board, in giving or withholding their consent, shall have regard to the industrial interests involved in the case, and to the circumstances and requirements of the locality.

The said Board shall not give their consent to proceedings by the sanitary authority of any district which is the seat of any manufacturing industry, unless they are satisfied, after due inquiry, that means for rendering harmless the poisonous, noxious, or polluting liquids proceeding from the processes of such manufactures are reasonably practicable and available under all the circumstances of the case, and that no material injury will be inflicted by such proceedings on the interests of such industry.

Any person within such district as aforesaid, against whom proceedings are proposed to be taken under this part of this Act, shall, notwithstanding

any consent of the Local Government Board, be at liberty to object before the sanitary authority to such proceedings being taken, and such authority shall, if required in writing by such person, afford him an opportunity of being heard against such proceedings being taken, so far as the same relate to his works or manufacturing processes. The sanitary authority shall thereupon allow such person to be heard by himself, agents, and witnesses, and after inquiry, such authority shall determine, having regard to all the considerations to which the Local Government Board are by this section directed to have regard, whether such proceedings as aforesaid shall or shall not be taken; and where any such sanitary authority has taken proceedings under this Act, it shall not be competent to other sanitary authorities to take proceedings under this Act till the party against whom such proceedings are intended shall have failed in reasonable time to carry out the order of any competent court under this Act.

PART IV.

Administration of Law.

7. Every sanitary or other local authority having sewers under their control shall give facilities for enabling manufacturers within their district to carry the liquids proceeding from their factories or manufacturing processes into such sewers:

Provided, that this section shall not extend to compel any sanitary or other local authority to admit into their sewers, any liquid which would prejudicially affect such sewers, or the disposal by sale, application to land, or otherwise, of the sewage matters conveyed along such sewers, or which would from its temperature or otherwise be injurious in a sanitary point of view:

Provided, also, that no sanitary authority shall be required to give such facilities as aforesaid where the sewers of such authority are only sufficient for the requirements of their district, nor where such facilities would interfere with any order of any court of competent jurisdiction respecting the sewage of such authority.

8. Every sanitary authority shall, subject to the restrictions in this Act contained, have power to enforce the provisions of this Act in relation to any stream being within or passing through or by any part of their district, and for that purpose to institute proceedings in respect of any offence against this Act which causes interference with the due flow within their district of any such stream, or the pollution within their district of any such stream, against any other sanitary authority or person, whether such offence is committed within or without the district of the first-named sanitary authority.

Any expenses incurred by a sanitary authority in the execution of this Act shall be payable as if they were expenses properly incurred by that authority in the execution of the Public Health Act, 1875.

Proceedings may also, subject to the restrictions in this Act contained, be instituted in respect of any offence against this Act by any person aggrieved by the commission of such offence.

9. The Conservancy Board constituted under the Lee Conservancy Act, 1868, shall, within the area of their jurisdiction, have, to the exclusion of any other authority, the powers for enforcing the provisions of this Act which sanitary authorities have under this Act.

The said Conservancy Board may also enforce the provisions of the Lee Conservancy Act, 1868, under the head or division, "Protection of Water,"

by application to the county court having jurisdiction in the place in which any offence is committed against those provisions; and such court may by summary order require any person to abstain from the commission of any such offence, and the provisions of this Act with respect to summary orders of county courts and appeal therefrom shall apply accordingly.

Legal Proceedings. Saving Clauses. Definitions.

(1.) *Legal Proceedings.*

10. The county court having jurisdiction in the place where any offence against this Act is committed may by summary order require any person to abstain from the commission of such offence, and where such offence consists in default to perform a duty under this Act may require him to perform such duty in manner in the said order specified; the court may insert in any order such conditions as to time or mode of action as it may think just, and may suspend or rescind any order on such undertaking being given or condition being performed as it may think just, and generally may give such directions for carrying into effect any order as to the court seems meet. Previous to granting such order, the court may, if it think fit, remit to skilled parties to report on the "best practicable and available means," and the nature and cost of the works and apparatus required, who shall in all cases take into consideration the reasonableness of the expense involved in their report.

Any person making default in complying with any requirement of an order of a county court made in pursuance of this section shall pay to the person complaining, or such other person as the court may direct, such sum, not exceeding fifty pounds a day for every day during which he is in default, as the court may order; and such penalty shall be enforced in the same manner as any debt adjudged to be due by the court; moreover, if any person so in default persists in disobeying any requirement of any such order for a period of not less than a month, or such other period less than a month as may be prescribed by such order, the court may in addition to any penalty it may impose appoint any person or persons to carry into effect such order, and all expenses incurred by any such person or persons to such amount as may be allowed by the county court shall be deemed to be a debt due from the person in default to the person or persons executing such order, and may be recovered accordingly in the county court.

11. If either party in any proceedings before the county court under this Act feels aggrieved by the decision of the court in point of law, or on the merits, or in respect of the admission or rejection of any evidence, he may appeal from that decision to the High Court of Justice.

The appeal shall be in the form of a special case to be agreed upon by both parties or their attorneys, and, if they cannot agree, to be settled by the judge of the county court upon the application of the parties or their attorneys.

The court of appeal may draw any inferences from the facts stated in the case that a jury might draw from facts stated by witnesses.

Subject to the provisions of this section, all the enactments, rules, and orders relating to proceedings in actions in county courts, and to enforcing judgments in county courts and appeals from decisions of the county court judges and to the conditions of such appeals, and to the power of the superior courts on such appeals, shall apply to all proceedings under this Act, and to an appeal from such action, in the same manner as if such action and appeal related to a matter within the ordinary jurisdiction of the court.

Any plaint entered in a county court under this Act may be removed into the High Court of Justice by leave of any judge of the said High Court, if it appears to such judge desirable in the interests of justice that such case should be tried in the first instance in the High Court of Justice, and not in a county court, and on such terms as to security for and payment of costs, and such other terms (if any) as such judge may think fit.

12. A certificate granted by an inspector of proper qualifications, appointed for the purposes of this Act by the Local Government Board to the effect that the means used for rendering harmless any sewage matter or poisonous, noxious, or polluting solid or liquid matter falling or flowing or carried into any stream, are the best or only practicable and available means under the circumstances of the particular case, shall in all courts and all proceedings under this Act be conclusive evidence of the fact; such certificate shall continue in force for a period to be named therein, not exceeding two years, and at the expiration of that period may be renewed for the like or any less period.

All expenses incurred in or about obtaining a certificate under this section shall be paid by the applicant for the same.

Any person aggrieved by the grant or the withholding of a certificate under this section may appeal to the Local Government Board against the decision of the Inspector; and the Board may either confirm, reverse, or modify his decision, and may make such order as to the party or parties by whom the costs of the appeal are to be borne as to the said Board may appear just.

13. Proceedings shall not be taken under this Act against any person for any offence against the provisions of Parts II. and III. of this Act until the expiration of twelve months after the passing of this Act; nor shall proceedings in any case be taken under this Act for any offence against this Act until the expiration of two months after written notice of the intention to take such proceedings has been given to the offender, nor shall proceedings under this Act be taken for any offence against this Act while other proceedings in relation to such offence are pending.

14. The Local Government Board may make orders as to the costs incurred by them in relation to inquiries instituted by them under this Act, and as to the parties by whom such costs shall be borne; and every such order and every order for the payment of costs made by the said Board under section twelve of this Act may be made a rule of Her Majesty's High Court of Justice.

15. Inspectors of the Local Government Board shall, for the purposes of any inquiry directed by the Board under this Act, have in relation to witnesses and their examination, the production of papers and accounts, and the inspection of places and matters required to be inspected, similar powers to those which the inspectors of the said Board have under the Public Health Act, 1875, for the purposes of that Act.

(2.) *Saving Clauses.*

16. The powers given by this Act shall not be deemed to prejudice or affect any other rights or powers now existing or vested in any person or persons by Act of Parliament, law, or custom, and such other rights or powers may be exercised in the same manner as if this Act had not passed; and nothing in this Act shall legalize any act or default which would but for this Act be deemed to be a nuisance or otherwise contrary to law: Provided, nevertheless, that in any proceedings for enforcing against any person such rights or

powers the court before which such proceedings are pending shall take into consideration any certificate granted to such person under this Act.

17. This Act shall not apply to or affect the lawful exercise of any rights of impounding or diverting water.

18. Nothing in or done under this Act shall extend to interfere with, take away, abridge, or prejudicially affect any right, power, authority, jurisdiction, or privilege given by "The Thames Conservancy Acts, 1857 and 1864," or by "The Thames Navigation Act, 1866," or by the Lee Conservancy Act, 1868, or any Act or Acts extending or amending the said Acts or either of them, or affect any outfall or other works of the Metropolitan Board of Works (although beyond the metropolis) executed under the Metropolis Management Act, 1855, and the Acts amending or extending the same, or take away, abridge, or prejudicially affect any right, power, authority, jurisdiction, or privilege of the Metropolitan Board of Works.

19. Where any local authority, or any urban or rural sanitary authority, has been empowered or required by any Act of Parliament to carry any sewage into the sea, or any tidal water, nothing done by such authority in pursuance of such enactment, shall be deemed to be an offence against this Act.

(3.) *Definitions.*

20. In this Act, if not inconsistent with the context, the following terms have the meanings hereinafter respectively assigned to them; that is to say,—

"Person" includes any body of persons, whether corporate or unincorporate.

"Stream" includes the sea to such extent, and tidal waters to such point, as may, after local inquiry and on sanitary grounds, be determined by the Local Government Board, by order published in the London Gazette. Save as aforesaid, it includes rivers, streams, canals, lakes, and water-courses, other than water-courses at the passing of this Act mainly used as sewers, and emptying directly into the sea, or tidal waters which have not been determined to be streams within the meaning of this Act by such order as aforesaid.

"Solid matter" shall not include particles of matter in suspension in water.

"Polluting" shall not include innocuous discoloration.

"Sanitary authority" means—

In the metropolis, as defined by the Metropolis Management Act, 1855, any local authority acting in the execution of the Nuisance Removal for England Act, 1855, and the Acts amending the same.

Elsewhere in England, any urban or rural sanitary authority acting in the execution of the Public Health Act, 1875.

The "application of the Act" to Scotland and Ireland is omitted here, as consisting chiefly in definitions and explanations, and as being, therefore, irrelevant to our circumstances.

THE DISPOSAL OF SEWAGE.

Irrigation.

Sewage-irrigation has already been in successful operation for a few years at the state asylums for the insane in August Me., and Concord, N. H., in the latter case by means of pumping; but although the crops have very much increased in value in these places, the sewage has not been disposed of in that systematic way which would be necessary in dealing with larger quantities. In fact, there have been a few complaints on the part of people living near the irrigated land in Concord, but it is said that the difficulties have always been readily obviated.

Experiments in Massachusetts.

Before dealing with sewage on a large scale, however, it is important that we should have more experience to guide us in regard to some matters which can be decided only by the facts. We shall look, therefore, with a great deal of interest for the results of the systems of sewage-irrigation which are now preparing at the new asylum for the insane at Worcester and at the state prison for women at Sherborn. The sewage of the new prison for men in Concord is to be utilized also. In Lenox, Colonel Waring has carried out the system of irrigation by underground pipes, of Mr. Rogers Field of London, including his flush-tanks, the same, indeed, which has been used by Colonel Waring for his own residence in Newport for some years, and which was described on page 334 of the Seventh Report of the State Board of Health.*

The accompanying map of the sewage-farm at Worcester explains itself. There are nearly fourteen acres of land available. The several side-outlets of the main sewer allow of winter-irrigation on plots not used in summer; and during

* Mr. J. Netten Radcliffe's statement that these should be cleaned once a year was there inadvertently given as Colonel Waring's, who, on the contrary, thinks that such frequent cleansing is not necessary.

wet weather, or when for any reason the sewage is not required for the growing crops, it may be passed on to several acres of growing grass at the various points where there are side-outlets.* The farm of the asylum consists of 275 acres.

Progress Elsewhere.

In other countries, some valuable experience and information have been got during the year, and brief reference will be made here to such as have some important bearing on our subject, although they, in the main, simply confirm the statements which were made in the previous report.

Glasgow.

The last report on the sewerage of Glasgow † recommends a main drainage-scheme similar to that advised by Bateman and Bazalgette in 1868, but to follow the valley of the Clyde and discharge at the mouth of the river, twenty-three miles below the city, instead of passing twenty-seven miles southwest, to a point on the coast, and using the sewage in irrigation on eleven thousand acres of land, as was proposed in 1868. The various dry-earth systems, on so vast a scale, were condemned, as inferior to water-carriage. All the processes of sewage-utilization were declared more costly than discharging into a large body of water, and no more satisfactory from a sanitary point of view. Of the best method, irrigation, it is stated that—

“The cost of the distribution of sewage over the land would not increase in direct proportion to the area irrigated, but at a greater rate; nor have we any experience of how far the nuisance of a large area of many thousand acres, irrigated with sewage, would extend. On these grounds, it is not safe to argue from small irrigation farms to large ones, either from an economical or a sanitary point of view.”

* Only one of these, that nearest to the sewage-farm, is represented on the map. There are six others between that point and the asylum.

† Report of Sir John Hawkshaw, the commissioner appointed to inquire as to the purification of the River Clyde, Edinburgh, 1876.

The Liernur System.

The difficulty of finding a suitable outlet for the water-carriage system, and of disposing of the sewage at all outlets, unless in deep water, has induced one of the first authorities in England* to recommend the Liernur system for trial in some parts of towns, although he says "it is probable that those in wealthy or in easy circumstances will not abandon willingly their water-closets, even if they be subject to a tax for them," and "the nicety of the present siphon-pans and water-closets will have to be surrendered, and undoubtedly dirty rain-water, at times, and much dirty waste-water from houses daily, must run into adjacent water-courses."

The Master of Public Works has advised that this system be extended in the upper parts of Amsterdam, where about one-fiftieth of the city is already supplied with it, and that dry removal be adopted in the lower quarters.

Precipitating Processes.

When the last report of the State Board of Health was published, the precipitating processes at Coventry and Leeds seemed to be the best of those then in use.

Coventry.

With regard to Coventry, it has been impossible to ascertain anything definite as to the cost of the "manure" made; and the same company have been placed under chancery injunction for their works at Nuneaton, because of the nuisance created there from insufficient cleansing of the sewage.

"Two manufacturers at Kenilworth (one a tanner discharging 5,000 gallons, and the other a fellmonger discharging 50,000 gallons, of refuse daily into the Finham Brook, which, like the Sherbourne, is one of the tributaries of the River Avon) have taken a license of this company, and are now erecting the necessary works to purify, at their own expense, their refuse by the same processes as are used at Coventry. The cost of purifying the tanner's refuse will be about 10d., and that of the fellmonger's about 2s. 6d. per day."

* Report on Captain Liernur's System of Sewerage, by William Haywood, Engineer and Surveyor to the Commissioners of Sewers of London, 1876.

Leeds.*

With regard to Leeds, the chairman of the Native Guano Company has published an account,† which would of course put the matter in the best light possible.

He gives the results of Dr. Letheby's examinations of the effluents made September, 1875, and January, 1876, and shows that they came within the standards demanded by the Rivers Pollution Commission and Thames Conservancy Board, at those times, when of course they were taking care to make the best effluent possible.

TABLE XIV.—*Examination of Effluent Water of the A B C Precipitating Process, at Leeds.*
[Results given in Parts per 100,000.]

	DR. LETHEBY'S ANALYSIS OF EFFLUENT FROM LEEDS SEWAGE.		STANDARD DEMANDED BY THE—	
	September, 1875.†	January, 1876.	Rivers Pollution Commiss'n.	Thames Conserva'cy Board.
<i>In Solution.</i>				
Actual ammonia,	1.47	1.75	—	—
Albuminoid ammonia, . . .	0.20	0.14	0.30	1.00
Total nitrogen as ammonia, . .	1.91	1.90	—	—
Chloride of sodium,	16.85	15.85	—	—
Mineral matter,	77.99	68.68	—	—
Organic matter,	6.56	9.01	—	—
Total solids in solution, . . .	84.55	77.69	—	140.00
Organic carbon (estimated), . .	1.31	1.80	2.00	2.80
<i>In Suspension.</i>				
Mineral matter,	0.31	1.37	3.00	—
Organic matter,	0.45	0.71	1.00	—
Total solids in suspension, . .	0.76	2.08	4.00	7.00

* By some unaccountable error, probably in copying, the precipitating tanks at Leeds were described in the last report (p. 849) as being of iron and six in number; whereas they are stone-faced, and consist of *two sets* of six each, with a double channel between them. The *cisterns* into which the sewage passes before entering the tanks are of iron.

† Report on Recent Trials of the A B C Process, made by the Leeds Corporation; by William Crookes, F. R. S. London, 1876.

‡ Samples for examination were taken every two hours for two weeks. Dr. Letheby's analyses were calculated in grains per gallon, but they are given here in this way for the sake of uniformity with the other tables.

Leeds Effluent Compared with Others.

Mr. Crookes says :—

“ In Dr. Letheby’s report, he speaks of the effluent water having an offensive smell. - This is not unlikely, considering that it had been kept closely stoppered for a week or more.”

Sir John Hawkshaw says, too, in the report just quoted :—

“ The effluent water at Leeds is not by any means pure, but might be rendered so by a larger expenditure in deodorizing substances and precipitants, and by an outlay on filter-beds.”

This effluent would be pure enough in many cases, but is far below the standard which may be got in irrigation, as may be seen by the following extract from recognized authorities :—*

“ At Croydon, the purification of the sewage of that town, by passing over grass-lands in the immediate neighborhood, has been so successful that people residing close up to the sewage-irrigated land do not complain of any nuisance ; and so entirely devoid of color, smell or taste is the sewage after having passed over the ground, that on comparing a bottle of it with a bottle of water from Loch Katrine, without knowing in which bottle the respective waters were contained, one of us actually selected the Croydon sewage water as being that which he believed was Loch Katrine water.† Similar results have attended its application at Rugby, Carlisle, Barking, and other places, and there can therefore be no doubt whatever that foul sewage after being properly and sufficiently passed over suitable land, and applied to suitable crops, may be wholly deprived of its offensive character.”

Present Methods in Leeds.

The authorities of Leeds advertised some years ago, on the failure of the Native Guano Company, for proposals to deal with their sewage, and got answers from ten individuals or companies ; of which the Clarifying and Utilization of Sewage Company, now at work in Leeds, represents one, Goodall’s process (modified A B C).

* Report on the Sewerage of Glasgow, 1868. By J. F. Bateman and J. W. Bazalgette, p. 22.

† Dr. Carpenter kept a bottle of this water for a year without any change taking place in it.

The chairman of the Utilization of Sewage Committee of Leeds expressed himself as follows in regard to the present works, under date of February 29, 1876 :—

“The sludge has not yet been converted by us into a salable manure, but four drying cylinders are just ready for use and will at once be set to work ; it remains to be proved whether the sale of the manure will pay for the expenses incurred in the manufacture, but, from replies received from many farmers and gardeners who have used some manufactured at the experimental works, it appears to be well suited for grass-land, garden-produce, plants and flowers. Up to the present time we know of no system more likely to answer our requirements.”

Hille's Process.

Hille's process (chloride of magnesium and lime) has lately been introduced in Edmonton (population 15,000) and Tottenham (population 23,500), followed by filtration, and is said to have been very successful. Capt. L. Flower, C. E., of the Lee Conservancy Board, says of it :—

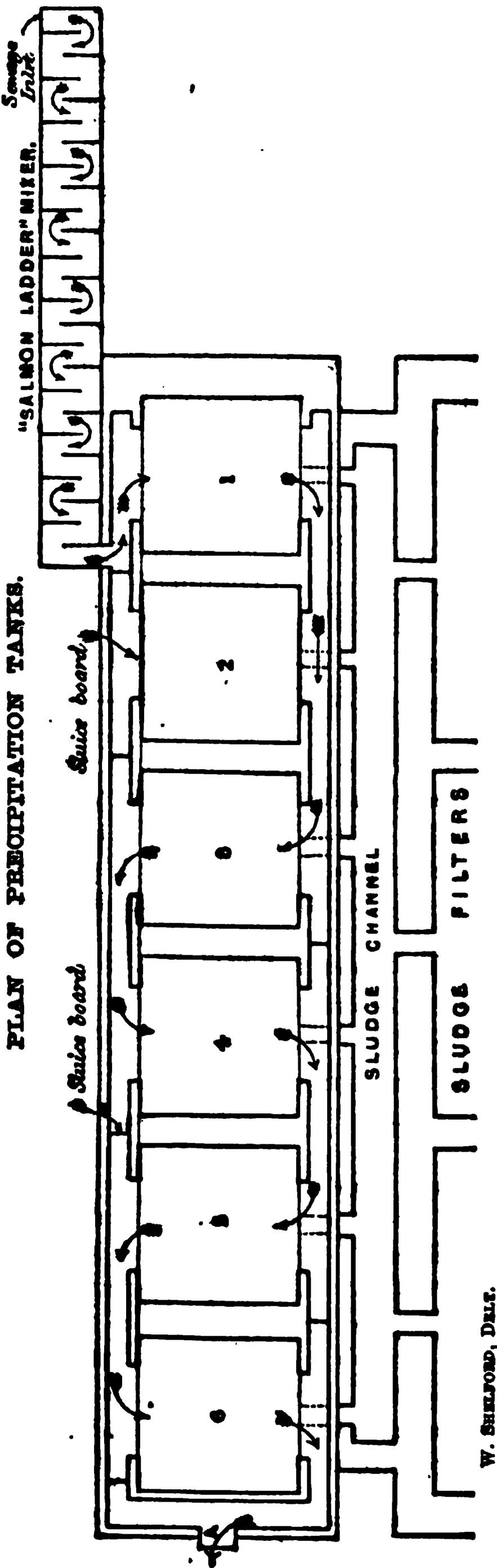
“An effluent sufficiently pure for sanitary purposes is now discharged ; there is also an absence of nuisance at the works such as I have not met with elsewhere. . . . The lime process and its residue were abominations. The Whitthread process, apart from the smell of the sludge and the cost, was an improvement.”

The works at Tottenham, formerly used for the Whitthread process, are thus described* by William Shelford, M. Inst. C. E. His diagram of the tanks, etc., is also given (page 86), as being one of the simplest and best in use for the precipitating process :—

“The sewage was pumped up into the precipitating tanks at the rate of about one and a quarter million gallons per day, and a ‘salmon-ladder’ mixer . . . was placed between the pump and the tanks, through which the sewage flowed by gravitation at a velocity sufficient to prevent the subsidence of the chemicals, and with a disturbance enough to incorporate them thoroughly (inclination 1 : 28). The phosphate was added to the sewage at the top of the ladder, and the lime at any suitable point in its length. . . . The filters were constructed in the cheapest possible manner by

* Proceedings of the Institution of Civil Engineers, Vol. XLV. London, 1876.

MODEL WORKS AT WANDSWORTH ROAD.



forming the ground and draining its surface with agricultural drain-pipes, surrounding the whole with a small earthen bank two feet high and dividing the area into convenient apartments. The space was then filled with screened ashes to a minimum depth of one foot, and the sludge was run upon the top to a depth of about twelve inches. These filters were never constructed of a sufficient extent (to do which and roof them was estimated to cost £1,000), but their working was quite satisfactory."

The sludge, containing about ninety per cent. of water, was thus reduced so as to contain from sixty-five to seventy-five per cent., and was completely dried by artificial heat; but the smell from the chimneys necessitated the works being given up.

Sewage Precipitates Generally.

Mr. Robert Rawlinson, C. B., of the Local Government Board, and one of the First Rivers Pollution Commission, said of the sewage precipitates, before the Society of Arts Conference, May, 1876:—

"Whatever the value of the manure might be, it did not find a ready sale. When he was at Rochdale, he saw thousands of tons which the farmers would not take away. It was evident, therefore, that whatever the value might be, at the present time the price asked did not offer sufficient inducement for farmers to buy it."

Dry Removal.

Many towns in England, with all the difficulties of sewage-disposal staring them in the face, have adopted various systems of dry removal, which also have their objections. At Rochdale* and at Manchester,* the most satisfactory methods are used. In Rochdale, the ash-carts pour their contents into the hopper of a sifting-machine, which separates the fine ash, fine cinder, rough cinder, vegetable matter, glass, pots, and rags. The disposal of this refuse is by using the fine ash for manure, the fine and rough cinder for fuel for the steam-boilers and for sale; the vegetable matter is burnt, and the ash from it ground and added to the manure, for the sake of the potash; the clinkers and pots are ground up for mortar and cement, and the rags, glass, and iron sold. Thus the whole of the refuse collected is utilized and the nuisance of a tip obviated. In Manchester (population, 351,189; mortality,

* See pages 182, 183, and 184 of the Seventh Report of the State Board of Health.

28.4), about 20,000 tub-closets and 23,000 middens are in use; that there is a difference of opinion as to their efficacy, may be seen from the statement of Mr. Lewis Angell, C. E., Borough Engineer at East London, that anything more disgusting and unclean than the pail-system, as carried out at Manchester, he had never seen; but certainly this might be avoided with sufficient care.

Opinions of Experts.

The most important contribution to our knowledge on the disposition of sewage, during the year, has been from a conference of the leading sanitarians and engineers of England, under the auspices of the Society of Arts, held in London, May 9, 10, and 11, 1876, at which there were full reports and discussions on all branches of the subject. Very full returns were got from one hundred and sixty towns; of which twelve disposed of their sewage by direct irrigation, twenty-two by irrigation after treatment (subsidence of solid parts), three by subsidence, thirteen by filtration, seven by precipitation and filtration, nine by precipitation, eighty-one by discharge into streams, and in nineteen, cesspools and dry vaults were used instead of sewers. The results arrived at are embodied in the following report:—

“The chairman of the conference and the executive committee, after having carefully considered the information furnished from the various localities, as well as the facts brought forward during the conference, have to submit the following as the conclusions to which such information appears to lead:—

“1. In certain localities, where land at a reasonable price can be procured, with favorable natural gradients, with soil of a suitable quality, and in sufficient quantity, a sewage farm, if properly conducted, is apparently the best method of disposing of water-carried sewage. It is essential, however, to bear in mind that a profit should not be looked for by the locality establishing the sewage farm, and only a moderate one by the farmer.

“2. With regard to the various processes based upon subsidence, precipitation, or filtration, it is evident that by some of them a sufficiently purified effluent can be produced for discharge, without injurious result, *into water-courses and rivers of sufficient magnitude for its considerable dilution*;* and that for many towns, where land

* The italics are mine.—[ED.]

is not readily obtained at a moderate price, those particular processes afford the most suitable means of disposing of water-carried sewage. It appears, further, that the sludge, in a manurial point of view, is of low and uncertain commercial value; that the cost of its conversion into a valuable manure will preclude the attainment of any adequate return on the outlay and working expenses connected therewith, and that means must therefore be used for getting rid of it without reference to possible profit.

“8. In towns where a water-carried system is employed, a rapid flow, thorough ventilation, a proper connection of the house drains and pipes with the sewers, and their arrangement and maintenance in an efficient condition, are absolutely essential as regards health; hitherto sufficient precautions have rarely been taken for efficiently insuring all the foregoing conditions.

“4. With regard to the various dry systems, where collection at short intervals is properly carried out, the result appears to be satisfactory; but no really profitable application of any of them appears as yet to have been accomplished.

“5. The old midden or privy system, in populous districts, should be discontinued, and prohibited by law.

“6. Sufficient information was not brought forward at the conference to enable the committee to express an opinion in regard to any of the foreign systems.

“7. It was conclusively shown that no one system for disposing of sewage could be adopted for universal use; that different localities require different methods, to suit their special peculiarities, and also that, as a rule, no profit can be derived at present from sewage utilization.

“8. For health's sake, without consideration of commercial profit, sewage and excreta must be got rid of at any cost.

“The executive committee, whilst abstaining from submitting any extensive measures, have no hesitation in recommending that the prevention of dangerous effects from sewage gases should receive the immediate attention of the Legislature, and they submit the following resolutions as the basis of petitions to Parliament:—

“1. That the protection of public health from typhoid and other diseases, demands that an amending Act of Parliament be passed, as soon as possible, to secure that all house drains connected with public sewers in the metropolis, and towns having an urban authority, should be placed under the inspection and control of local sanitary authorities, who shall be bound to see to the effective construction and due maintenance of all such house drains, pipes, and connections. Provisions having this object in view already exist in the Act constituting the Commissioners of Sewers in the City of

London, in the Metropolis Local Management Act, 1855, and in the Public Health Act, 1875, but practically they seem scarcely sufficient for the purpose.

“ 2. That plans of such drains and connections be deposited in the charge of the respective local authorities, who shall be bound to exhibit them and supply copies of them to the public on payment of a moderate fee.

“ 3. That the owners of houses be compelled by law to send to the respective local authorities, within a specified time after the passing of the Act, plans of all house drains on an appointed scale.

“ (Signed by) The Right Hon. JAMES STANSFELD, M. P.,

“ *Chairman of the Conference.*

“ Lord ALFRED S. CHURCHILL, Chairman of the Council,

“ F. A. ABEL, F. R. S. President of the Chemical Society,

“ Sir HENRY COLE, K. C. B.,

“ Capt. DOUGLAS GALTON, R. E., C. B., F. R. S.,

“ Lt.-Col. E. F. DU CANE, R. E., C. B., Sur.-Gen. of Prisons,

“ *Members of the Executive Committee.*”

ENGLISH GOVERNMENT STATISTICS.

In March, 1876, very valuable statistics* were published by the Local Government Board of England, giving, as nearly as possible, the present state of the sewage question in that country. A large number of the 462 towns, for which the facts are stated, still use cesspools and vaults; the majority cast their sewage into some neighboring body of water. Where there are sewers, and there is, therefore, sewage to be disposed of, it is not in all cases stated for what part of the town sewers are built, and we cannot always judge from the population how much sewage is disposed of in each way.

Overflow of Sewage on Land.

This is the simplest way; *i. e.*, letting the sewage run over grass-land to be taken wholly or in part by farmers, an imperfect method, but good enough in certain places. This is used by thirteen towns having populations from 5,115 to 7,500. It costs nothing usually, and there is also no profit to the

* Return pursuant to an order of the House of Lords, dated July 20, 1875, from every urban sanitary district in England and Wales having more than 5,000 inhabitants. London, 1876.

town. Of course there are no works to be built, if the flow is by gravitation. One town only of the thirteen reported any expense incurred for their last year (£54), possibly from pumping.

Filtration.

Filtration through gravel-land, prepared beds of cinders, etc., is in use in sixteen towns. The original works in ten are not stated as costing anything. There was an amount expended during the year in nine cases of twenty, twenty-three, twenty-five, fifty-two, sixty, seventy-seven, eighty-four, one hundred and thirty-seven, and one hundred and fifty pounds sterling respectively, and in the rest, nothing. In three cases there were figures under the column of profits; in one of twenty-five pounds (cost, one hundred and thirty-seven pounds), but it is stated that this was the amount received, and not the profit; in a second, of sixteen pounds (cost, twenty-five pounds), but it is stated elsewhere that this is the amount received simply; and in a third, of six pounds, in regard to which there is no statement; but the inference is that this also is simply the amount received, and presumably was from sludge sold. Of the sixteen towns,—

One had a population of 25,000.

Two had populations from 20,000 to 25,000.

Three had populations from 10,000 to 20,000.

Five had populations from 7,000 to 10,000.

Five had populations from 5,000 to 6,000.

Simple Subsidence.

The sewage of ten towns is disposed of in this way. One has a population of 43,000, and uses only partial subsidence; one has a population of 14,000; three from 9,000 to 10,000; and five, 7,000 and under. In only two is any expense reported for the year's work. In none was there any profit. Of course this method is very incomplete, and is satisfactory only when the works are on a small scale, remote from dwellings, and not required to accomplish more than a very partial cleansing of the sewage.

Subsidence and Filtration.

This is simply a modification of the last process. Of course only the rudest basins for precipitating are used, and the land is depended on for filtration. One only reported any original cost for their works (population, 14,000; cost, £391); the others have less than 7,500 inhabitants each. In none was there any profit; in two, small expenditures were reported.

Irrigation.

Forty-six towns irrigate with their sewage; of these, seven use subsidence-tanks for removing the heavier parts of the solids, and with the results shown in the following table.

In the next six tables, in nearly every case, the duration of the time is given of the process in use; in the fourth column, the cost of sewers is not included; in the fifth column, there is some difficulty in getting at the exact results, inasmuch as it is not always stated whether the interest on the original outlay is included, nor how much of the money was expended on permanent works; in the last column, the amount placed under the head of profit has, in some cases, been found, from other sources, to mean simply the receipts. The results are supposed to be, in most cases, for the year 1874. It will be noticed that the profits are often said to be *nil*, without any indication of the amount of the loss, if there was any.

TABLE XV.—*Results of Irrigation (with Subsidence-Tanks)—Seven Towns.*

URBAN SANITARY AUTHORITY.	Population.	The length of time during which any systems of artificial sewage treatment have been in opera- tion.	The total amount which has been expended for the artificial treat- ment of sewage.	The cost of car- rying on such sewage works during the last year for which accounts have been made.	The profit, if any, derived from these works, during the same period.
Banbury, .	11,718	Since 1874, .	£5,500	£590	£109 ¹
Blackburn, .	90,000	3 years, . .	88,750 ²	7,007	1,226 ¹
Brynmawr, .	7,000	9 years, . .	300	Nil.	Nil.
Epsom, . .	6,276	4 years, . .	8,626	244	Nil.
Northampton,	50,000	Since Jan. '71,	70,860 ²	"	1,922 ⁴
Penrith, . .	8,817	—	"	—	—
Wrexham, . .	8,537	4 years, . .	1,000 ³	Nil.	Nil.

¹ Loss.² Including land.³ Not stated.⁴ Return from sales of crops.⁵ Taken by a private individual at his own cost.⁶ Let to a private individual.

By the Society of Arts Conference, the following results are given : Banbury, expenses in 1875, not including interest on capital, £513; receipts from sale of crops, £1,450; for deposit in tanks, £30. Blackburn, average annual outlay, £768. Northampton, net cost of dealing with sewage, about £2,300 in 1875, including interest on works, probably.

TABLE XVI.—*Irrigation (with previous precipitating treatment)—Six Towns.*

URBAN SANITARY AUTHORITY.	Population.	The length of time during which any systems of arti- ficial sewage treatment have been in operation.	The total amount which has been expended for the arti- ficial treatment of sewage.	The cost of carrying on such sewage works during the last year for which accounts have been made.	The profit, if any, derived from these works, during the same period.
Bolton, . . .	90,000	1½ years, . . .	£16,578 ^a	£1,306	£1,007 ^a
Chester, ⁴ . . .	35,232	Since July, '75,	4,200	—	Nil.
Edmonton, . . .	15,000	4 months, . . .	1,929	175 ^b	Nil.
Harrow, . . .	5,010	6 years, . . .	4,324	124	Nil.
Tunbridge, . . .	9,000	3 years, . . .	3,500	208	Nil.
Watford, . . .	8,111	4 years, . . .	1,400	613	486 ^c

TABLE XVII.—*Irrigation (the farms being leased to private individuals)—Seven Towns.*

Enfield, . . .	17,000	—	—	—	—
Guisbrough, . . .	5,202	5 years, . . .	£1,552 ^d	—	£5 ¹⁰
Leamington, ⁷ . . .	20,917	Since 1872, . . .	16,000	£1,035	585 ¹¹
Leek (in part), . . .	11,732	—	Nil.	Nil.	Nil.
Ormkirk, . . .	6,127	—	—	Nil.	Nil.
Romford, . . .	6,335	—	Nil.	Nil.	Nil.
Worthing, . . .	9,000	12 years, . . .	12	—	10 ¹²

¹ In these two cases, it is probably the net cost that is given, and not the outlay.

² Works, £11,018; land, £5,560.

³ Loss.

⁴ A part of the sewage only is used.

⁵ Per year, estimated.

⁶ Produce of farm.

⁷ The Earl of Warwick pays £450 a year for the sewage, on a thirty years' lease; the town loses a little less than the cost of pumping the sewage, each year.

⁸ Expenses paid for use of sewage.

⁹ Paid by lessee.

¹⁰ Rent paid town.

¹¹ Loss.

¹² Company builds necessary works.

¹³ Per year.

TABLE XVIII.—*Simple Irrigation (the farms being carried on by the various towns)—Twenty-six Towns.*

URBAN SANITARY AUTHORITY.	Population.	The length of time during which any systems of artificial sewage treatment have been in operation.	The total amount which has been expended for the artificial treatment of sewage.	The cost of carrying on such sewage works during the last year for which accounts have been made.	The profit, if any, derived from these works, during the same period.
Altrincham, ¹ . . .	8,478	5 years, . . .	£3,000	£134	Nil.
Bedford, . . .	16,851	7 years, . . .	6,997	2,627	£180
Bishops Stortford, . .	6,250	3 to 4 years, . .	7,728	575	Nil.
Bury St. Edmunds, . .	14,928	8 years, . . .	1,930	336	Nil.
Chelmsford, . . .	9,500	Since 1866, . .	2,300	{ 250 to 300 }	Nil.
Chorley, . . .	18,000	6 years, . . .	16,550 ²	906	58 ³
Crewe, . . .	20,000	2 years, . . .	42,550 ²	5,368 ⁴	10
Croydon, . . .	55,652	18 years, . . .	21,740	11,947 ⁵	Nil
Doncaster, . . .	18,750	3 years, . . .	20,000	332	170
Gateshead, ⁷ . . .	48,627	— —	—	—	—
Harrogate, . . .	6,655	5 years, . . .	11,050	582	40 ³
Kidderminster, . . .	19,463	3 years, . . .	44,041	921	Nil.
Maidenhead, . . .	6,173	5 years, . . .	—	516	53 ³
Norwich, ¹ . . .	84,000	2 years, . . .	113,000	4,224	Nil.
Prescot, . . .	5,990	2 years, . . .	8,268	94	28
Reigate, . . .	15,910	4 years, . . .	3,463	440	128 ³
Rugby, . . .	8,500	20 years, . . .	5,800	344	85
Swindon New Town, . .	7,628	4 years, . . .	14,434	1,662	Nil.
Tunbridge Wells, . .	19,410	3 years, . . .	87,243	8,199	528 ³
Tyldesley and Shakerley, ⁸ . . .	8,400	— —	Nil.	Nil.	Nil.
Ware, . . .	5,362	— —	578	690	Nil.
Warwick, . . .	11,002	8 years, . . .	11,000	2,067 ³	996 ³
Wellington, . . .	6,283	— —	Nil.	Nil.	Nil.
West Derby, . . .	31,000	3 years, . . .	58,147	2,545	803 ³
Wolverhampton, . .	71,500	— —	38,000	4,451	646 ³

¹ Only part of the sewage is used.² Including land.³ Loss.⁴ Including interest.

⁵ This may mean only the receipts, and not the profits. Wolverhampton is returned as also filtering their sewage, although it is not known to the writer whether that means the separation of solids before irrigation, or whether it is part of the process of irrigation itself as the sewage passes through the soil.

⁶ Including repairs, fences, etc.⁷ The sewage of only 1,000 inhabitants is used.⁸ The sewage is disposed of to private parties.⁹ The cost of pumping alone was £671.

¹⁰ By the "Pall Mall Budget" of November 10, 1876, it is stated that the loss in 1875 was £3,919, and that it will be about £4,000 for 1876. These sums probably include interest on the capital invested, which, including cost of injunctions, etc., is stated to have been £70,000.

By the Society of Arts Conference, the net cost at Chelmsford was about £300, and the receipts £35 ; at Croydon, the net cost was £2,367 a year, but they pay enormous rents for their land, which is in the "Outer Ring" of London ; at Reigate, there was a loss of £104 in 1875, and at Altrincham there was some loss. At Eton, on the other hand, a village of 3,500 inhabitants, including the school, there was a profit of £120 ; but it is sewered on the separate system, keeping out rain-water, so that the sewage is quite concentrated.

*Intermittent Downward Filtration.**

This system is comparatively a new one, and has not yet been generally introduced, although several towns are now, since the return, beginning to go to work on that principle.

TABLE XIX.—*Intermittent Downward Filtration—Three Towns.*

URBAN SANITARY AUTHORITY.	Population.	The length of time during which any systems of arti- ficial sewage treatment have been in operation.	The total amount which has been expended for the arti- ficial treatment of sewage.	The cost of carrying on such sewage works during the last year for which accounts have been made.	The profit, if any, derived from these works, during the same period.
Kendal,	13,500	1½ years, . . .	£18,871	£110	£385 ¹
Merthyr Tydfil, ² . .	55,000	4 years, . . .	53,330	2,690	1,067 ³
Wellingborough, ⁴ . .	12,000	3 years, . . .	—	15	Nil.

¹ It is thought that this must mean receipts, which amounted to £150 the first season.

² Twenty-five acres only are used for the intermittent downward system ; a couple of hundred acres have been added for ordinary irrigation, and the preparation of that land may have been the cause of the high figures in the fifth and sixth columns.

³ Loss.

⁴ The farm is for only one-tenth of the population.

Precipitation.

Twenty-six towns precipitate their sewage, one-half of them filtering also.

* This is essentially the same as the *oxydation par colmatage*, which has been successfully applied near Paris by Gérardin in the case of several manufactories, and which has sufficiently purified the River Croult, previously very much contaminated.

TABLE XX.—Chemical Processes Alone—Thirteen Towns.

URBAN SANITARY AUTHORITY.	Population.	PROCESS IN USE.	The length of time during which any systems of artificial sewage treatment have been in operation.	The total amount which has been expended for the artificial treatment of sewage.	The cost of carrying on such sewage works during the last year for which accounts have been made.	The profit, if any, derived from these works, during the same period.
Accrington,	21,788	McDougall's disinfectant,	-	-	£813	Nil.
Birmingham,	366,325	Lime,	-	£100,800	31,994	£1,325 ¹
Burton-upon-Trent,	20,378	Lime,	New,	7,121	1,279	-
Coventry,	37,700	General Sewage and Manure Co.,	2 years,	-	-	-
Hertford,	7,169	Lime,	16 years,	3,500	400	Nil.
Hitchin,	-	Phosphate,	1 year,	2,000	-	-
Leeds,	8,000	Liming,	-	-	129	Nil.
Leicester,	285,000	A B C,	-	57,000	15,000 ³	Nil.
Luton,	108,000	Lime,	20 years,	30,000	2,116	83
Nuneaton,	17,316	Lime,	18 years,	7,000	600	592 ¹
Stroud,	7,392	General Sewage and Manure Co.,	Since 1872,	-	-	-
Tottenham,	8,001	Bird's process,	18 years,	79	100	Nil.
Waltham Holy Cross,	27,000	Whitbread process,	-	11,000 ⁴	1,979	65
	5,197	Lime,	2 years,	3,850	-	Nil.

¹ Loss. ² No answer. ³ At least, excluding interest. ⁴ More than 11,000, but not precisely ascertained.

We learn from the conference referred to that the net cost of dealing with the sewage in Leicester was £2,032,—so near £2,116—£83, as given in Table XX., that the difference may be accounted for by the fact that shillings and pence are not reckoned.* The figures of "profit" in the sixth column must, therefore, signify receipts only. In Birmingham, the net cost for one year was given as £12,710, which corresponds with the previous accounts of that city.† For Tottenham, the net annual cost for four years was £2,000 per annum, so that the profit of £65 is supposed to be to the credit of the town, while the great loss was probably on the persons who managed the sewage (Whitthread Company), for Mr. Shelford says,‡ writing at a later date,—

"It is unfortunate that the company was compelled by financial difficulties to hand over the works to the local board; and that, partly owing to the doubt entertained as to the power of a local board to trade in the manufacture of manure, the Whitthread process has been for the present abandoned."

Precipitation and Filtration.

Of the thirteen towns dealing with their sewage in this way, eleven return profits of "nil," and two losses of £25 and £400 respectively. One township reports the sewage as being disposed of in its different villages by subsidence, filtration, and irrigation.

Cost of Precipitation.

It is difficult to get at the cost of the precipitating processes exactly, because, where they are on a large scale and well carried out, they are generally in the hands of private companies. Mr. William Shelford, however, who was formerly engineer of the Native Guano Company (A B C), during their experiments with the sewage of London at Crossness, has published some important statistics on the subject.§ He says that the cost of precipitating the sludge and drying it enough for

* And yet "outlying villages object to contamination of the river by effluent sewage water."

† Seventh Report of the State Board of Health, page 351.

‡ Op. cit.

§ "The Treatment of Sewage by Precipitation." Proceedings of the Institution of Civil Engineers, Vol. XLV. London, 1875.

transportation, is thirty shillings a ton, and that anything over that sum is due to the chemicals, which may be cheap or expensive, sparingly used or in sufficient quantity. His opinion is, "In short, the success of precipitation depends on neutralizing the cost of the chemicals employed, or, in other words, upon the admixture of precipitants which have a manurial value, and upon the eventual recovery of that value in the dry manure." He has tabulated the results of various experiments thus :—

TABLE XXI.—*Results of Experiments in Precipitating Sewage in Large Quantities.*

PROCESS.	PLACE.	Dose per 1,000 gallons.	Cost of Manure per ton.		
		lbs.	£	s.	d.
A B C, . .	Crossness, London Outlet, .	31.80	5	16	4
A B C, . .	Leamington,	1.86	1	17	1
Campbell, .	Tottenham,	9.76	4	0	9
Whitthread, .	Tottenham,	2.00	3	3	0

Cost of Irrigation.

Irrigation, when well managed and not on too large a scale, seems likely to give very good results from a financial point of view, if no excessive sums are paid for expensive land, pumping, etc. ; but, like precipitation, in the majority of cases, there is a loss somewhere, if it is done well enough to be satisfactory. Its advocates, however, are gaining rather than losing confidence from their increased experience. Colonel Jones has been especially successful at Wrexham, where, according to Mr. Eyton Jones, mayor of the town, "they have eighty-four acres at £5 an acre, which they sublet to Colonel Jones, who paid them a profit rent of £30 a year, and yet he made £300 a year profit by it, besides setting aside a sinking fund annually to recoup himself on his capital account."

Colonel Jones, too, has recently offered to take a lease of the West Derby Farm (two hundred acres, with sewage from a population of about 20,000) at the usual rent of adjoining land, proposing to occupy his spare time in superintending this new farm, in addition to the one which he has now got

into pretty regular working order at Wrexham, although the two places are separated by about thirty miles of railway.

The Earl of Dudley has offered to take the sewage of Dudley, building at his own cost the necessary works, thereby, according to the "Pall Mall Budget" of October 6, 1876, saving the town an immediate outlay of £50,000.

The Earl of Warwick's farm at Leamington is said to be satisfactory to him, but no accounts are published of the pecuniary result.

Cost of Barking Farm.

The farm at Barking, with an area of two hundred and twelve acres, where a small part of the sewage of London was utilized as an experiment, gives the following as the results of six years' experience:—

	Profit.			Loss.		
	£	s.	d.	£	s.	d.
Year ending August 31, 1870,	619	4	1			
31, 1871,	1,324	11	6			
Sixteen months ending December 31, 1872,				90	11	5
Year ending December 31, 1873,				448	2	3
31, 1874,				256	1	0
31, 1875,				292	7	0

"The years ending August 31, 1870 and 1871, were favorable to sewage, being without rain. The land was new to sewage, and we were also selling milk, which is, perhaps, the most profitable method of turning sewage to account. The average cost of pumping the sewage to a height varying from about thirty-five to forty feet, through a main rather over one and a half miles in length, is about £450 per annum, without allowing anything for depreciation in machinery, etc. This is not included in the lists of payments," and, therefore, is not reckoned in the account.

Cost of Cheltenham Farm.

The accounts of Cheltenham (population, 41,923) show a very fair result to the town from leasing the sewage-irrigated land (two hundred acres) to farmers; but, unfortunately,

only "a fair effluent has been obtained," as the lessees are intent on profitable farming rather than purifying sewage. Subsidence tanks are used, from which there must be a great stench; and the authorities seem to have excellent success in selling the sludge mixed with ashes, at two shillings per cubic yard, from which part of the process there was an average annual profit of £52 15s. 9d. for the five years.

Cheltenham Sewage Farm—Balance Sheet.

RECEIPTS.				1871.	PAYMENTS.			
	£	s.	d.			£	s.	d.
Rents,	899	12	0		Wages, tradesmen's bills, and other expenses, .	286	2	11
Fluid sewage, . .	75	10	0		Rates and taxes, . . .	26	19	8
Deficiency, . . .	134	15	0		Interest on loan, . . .	796	14	5
	<hr/>					<hr/>		
	£1,109	17	0			£1,109	17	0
				1872.				
	£	s.	d.		Wages, tradesmen's bills, and other expenses, .	280	15	5
Rents,	868	15	10		Rates and taxes, . . .	27	14	10
Fluid sewage, . .	142	0	0		Interest on loan, . . .	782	17	0
Deficiency, . . .	80	11	5			<hr/>		
	<hr/>					£1,091	7	3
	£1,091	7	3					
				1873.				
	£	s.	d.		Wages, tradesmen's bills, and other expenses, .	286	7	0
Rents, etc., . . .	936	19	6		Rates and taxes, . . .	52	2	0
Fluid sewage, . .	131	10	0		Interest on loan, . . .	768	7	0
Deficiency, . . .	38	7	5			<hr/>		
	<hr/>					£1,106	16	11
	£1,106	16	11					
				1874.				
	£	s.	d.		Wages, tradesmen's bills, and other expenses, .	253	3	4
Rents, etc., . . .	848	14	9		Rates and taxes, . . .	47	4	0
Fluid sewage, . .	86	12	6		Interest on loan, . . .	753	4	0
Deficiency, . . .	118	4	1			<hr/>		
	<hr/>					£1,053	11	4
	£1,053	11	4					
				1875.				
	£	s.	d.		Wages, tradesmen's bills, and other expenses, .	396	5	4
Rents, etc., . . .	890	8	5		Rates and taxes, . . .	31	4	9
Fluid sewage, . .	145	18	0		Interest on loan, . . .	737	7	4
Deficiency, . . .	128	11	0			<hr/>		
	<hr/>					£1,164	17	5
	£1,164	17	5					

Cheltenham was reported so indefinitely in the returns already given,* that it was not thought to be disposing of its sewage by irrigation. It should, therefore, be added to the list of towns in Table XV.

* See page 90.

Cost of Bedford Farm.

The accounts of the sewage farm managed by the Borough of Bedford, show a considerable loss in 1875, especially when compared with the fair profit of £180 15s. 4d. in 1874.* A considerable part of this expenditure is for pumping.

Mr. John Lund, the Borough Engineer, kindly informs me that the loss for 1876 is estimated to be about £169.

Bedford Irrigation Farm.

GENERAL ACCOUNT AND BALANCE SHEET FOR YEAR ENDING 31st DEC., 1875.

Dr.				Cr.			
	£	s.	d.		£	s.	d.
To stock, 31st Dec., 1874,	544	8	0	By sales of crops by			
working plant, 31st				auction, .	1,807	19	9
Dec., 1874, .	269	9	0	sales of crops by			
labor, .	510	16	11	manager, .	387	11	8
manager's salary, .	134	3	0	stock in hand, 31st			
engineer's ditto, .	69	11	6	Dec., 1875, .	418	4	0
coals, .	274	15	10	working plant and			
horse, corn, keep, and				live stock, 31st			
straw, .	91	13	6	Dec., 1875, .	330	14	6
horse, .	25	0	0	sewage works, .	10	8	6
machinery, .	46	9	1	balance carried down,	351	7	5
seeds and plants, .	107	15	0				
hire of horses, .	13	14	6				
permanent works, .	10	8	6				
auctioneer's commis-							
sion and expenses,	111	3	3				
rents, .	917	4	0				
poor-rates, .	92	0	3				
income tax, .	18	3	2				
land tax, .	3	1	2				
insurance, .	0	10	0				
miscellaneous trades-							
men's bills, .	65	19	2				
	£3,306	5	10		£3,306	5	10
To balance, .	£351	7	5				

Cost of Dry Removal.

It is interesting to compare with these accounts of precipitation and irrigation the great cost of the dry-removal methods. In Manchester, there are "about 20,000 tub-closets and 23,000

* Compare the Seventh Report of the State Board of Health, p. 382.

Lancashire middens [*i. e.*, privies] in use; night-soil is mixed with ashes; a portion is made into concentrated manure, and the remainder sold as common night-soil. Net cost of disposing of night-soil in 1875, after deducting receipts, £22,839 2s. 7d.; scavenging, £22,151 7s. 11d. The tub system has been found to be the best method of disposal of night-soil."

In Rochdale, the quantities collected weekly vary as the system is extended. For the week ending April 12, the quantities were 118 tons of excreta and 208 tons of refuse material, from an estimated population of 52,000, and the weekly cost, £74, excluding interest and depreciation, or 4s. 7½d. per ton, or £30 per 1,000 people. The total excreta collected last year was 5,398 tons, and of refuse 8,652 tons. The work is done by eighteen carters, eighteen guards, eighteen horses, three washers, one laborer, four inspectors, one horse-keeper, and one book-keeper.

Cost of No Removal of Sewage.

The sums, too, which have been spent in litigation and on account of injunctions, have been in some cases enormous; for instance: Baldock, £280; Barnsley, £1,468; Birmingham, over £10,000; Blackburn, £20,000; Chelmsford, £200; Crewe, £1,050; Kendal, £700; Leamington, over £2,000; Merthyr Tydfil, £10,675; Northampton, £12,000 to £15,000; Ormskirk, £650; Richmond, £2,000. In the latter town, they were compelled, against their own wishes, to take their sewage into the Thames, at a cost of about £20,000. Scarcely had the debt incurred in doing so been paid off, than they were called upon to take the sewage from the river.

Conclusions of English Local Government Board.

While this paper was going through the press, the report of a committee appointed by the Local Government Board of England to inquire into the several modes of Treating Farm Sewage, was received,—a most valuable document, of which only the conclusions can be given here. Mr. Rawlinson, the chief engineering inspector of the Local Government Board,

was a member of the First Rivers Pollution Commission; Mr. Smith was secretary of the second commission.

CONCLUSIONS.

1. That the scavenging, sewerage, and cleansing of towns are necessary for comfort and health, and that, in all cases, these operations involve questions of how to remove the refuse of towns in the safest manner and at the least expense to the rate-payer.

2. That the retention, for any lengthened period, of refuse and excreta in privy-cesspits, or in cesspools, or at stables, cow-sheds, slaughter-houses, or other places in the midst of towns, must be utterly condemned; and that none of the (so-called) dry-earth or pail systems, or improved privies, can be approved, other than as palliatives for cesspit-middens, because the excreta is liable to be a nuisance during the period of its retention, and a cause of nuisance in its removal; and, moreover, when removed, leaves the crude sewage, unless otherwise dealt with by filtration through land, to pollute any water-course or river into which such sewage may flow. We have no desire, however, to condemn the dry-earth or pail systems for detached houses, or for public institutions in the country, or for villages, provided the system adopted is carefully carried out.

3. That the sewerage of towns and the draining of houses must be considered a prime necessity under all conditions and circumstances, so that the subsoil water may be lowered in wet districts, and may be preserved from pollution, and that waste water may be removed from houses without delay; and that the surfaces and channels of streets, yards, and courts may be preserved clean.

4. That most rivers and streams are polluted by a discharge into them of crude sewage, which practice is highly objectionable.

5. That, as far as we have been able to ascertain, none of the existing modes of treating town-sewage by deposition and by chemicals in tanks appear to effect much change beyond the separation of the solids, and the clarification of the liquid. That the treatment of sewage in this manner, however, effects a considerable improvement, and, when carried to its greatest perfection, may, in some cases, be accepted.

6. That, so far as our examinations extend, none of the manufactured manures made by manipulating town's refuse, with or without chemicals, pay the contingent costs of such modes of treatment; neither has any mode of dealing separately with excreta, so as to defray the cost of collection and preparation by a sale of the manure, been brought under our notice.

7. That town-sewage can best and most cheaply be disposed of and purified by the process of land-irrigation for agricultural purposes, where local conditions are favorable to its application, but that the chemical value of sewage is greatly reduced to the farmer by the fact that it must be disposed of day by day throughout the entire year, and that its volume is generally greatest when it is of the least service to the land.

8. That land-irrigation is not practicable in all cases, and, therefore, other modes of dealing with sewage must be allowed.

9. That towns, situate on the sea-coast, or on tidal estuaries, may be allowed to turn sewage into the sea or estuary, below the line of low water, provided no nuisance is caused; and that such mode of getting rid of sewage may be allowed and justified on the score of economy.

ROBERT RAWLINSON.

CLARE SEWELL READ.

S. J. SMITH, *Assistant*.

JULY 21, 1876.

EXPERIENCE IN GERMANY.

On the continent of Europe, the work of sewerage cities goes on slowly, as there are strong prejudices in favor of more primitive methods to be overcome. The sewers of Frankfort-on-the-Main, built under the direction of the distinguished English engineer, Lindley, are without question the finest in the world. Düsseldorf, Crefeld, Basel, Stuttgart, Heilbronn, Munich, and Hanau have introduced or are introducing similar sewerage after the same plans. In a paper read before the International Congress at Brussels, Mr. Lindley said that it was proposed to deal with the sewage of Frankfort by irrigation, as soon as the amount of pollution to the river Main demanded it.

Berlin.

In Berlin, over sixteen hundred acres of land have been bought for the third "radial system" (two German miles south-west from the city), and the sewerage of the streets is going on rapidly, to be finished probably this winter. Somewhat more land than for the south-western district has been bought for the fourth "radial system," north-west of the

city, and the work is probably already begun. The disposal of the sewage of a city of over three-quarters of a million inhabitants, by irrigation, is certainly a bold undertaking, and the results will be looked for with great interest.

AUSTRIA.

Under the German laws, allowing local authorities to require manufacturers to cease from contaminating streams, when they think the occasion demands such action, one case has come to my knowledge during the year. In a large brewery near Vienna, where one thousand cubic meters of water were polluted daily, defiling an otherwise pure stream, measures were taking* to close the establishment, when the proprietors clarified their refuse by precipitating with sesquichloride of iron, with such success that further action was stopped.†

FRANCE.

Objections to Irrigation below Paris.

In Paris, the proposition of the authorities to extend the system of sewage-irrigation so as to dispose of the whole three hundred thousand meters discharged daily, has called forth loud protests in the form of petitions and addresses‡ and propositions of other remedies for the pollution of the Seine, which is really a filthy sewer, and very offensive to people living on its banks, for many miles below the sewer-outlets.

* The law in Austria punishes with a fine any one who casts into any well, cistern, river, or brook *used for drinking, or for brewing beer*, any dead animal, or *anything else* whereby the water is polluted and rendered unwholesome.

† La Santé Publique, April 1, 1876.

‡ *Traitement des Eaux d'Égout: Traitement des Eaux Industrielles.* A. Gérardin, Société Générale d'Épuration et d'Assainissement des Villes. Paris. 1876.

Mémoire sur L'avant-Projet de Dérivation des Eaux d'Égout de la Ville de Paris, par M. le Dr. Salet, Président du Comité d'initiative.

Des Résultats de l'irrigation de Gennevilliers par les eaux d'égout de la Ville de Paris. Étude par les docteurs Danet, Bestin, et Garrigon-Desarènes. Paris. 1876.

Assainissement de Paris. Épuration des Eaux d'Égout et des matières de vidange. Application des Procédés Knab. Paris. Société Générale d'Épuration et d'Assainissement des Villes. 1876.

L'Assainissement de Paris et la Société provisoire de Bondy. Justin Dromel. Paris. 1875.

Sewage of Paris.

About four hundred and fifteen thousand cubic meters of water are used in Paris daily; nine-tenths of the cesspool-drainage are still unconnected with the sewers, but, after being removed to the forests of Bondy, drain away a very large part of their liquid constituents into the main sewer, discharging at St. Denis; the other intercepting sewer, draining the better parts of the city, has little or no manufacturing refuse poured into it, and is some distance higher up the river, while, between the two local sewers, drains from factories, and a few polluted tributaries * of the Seine, empty into the river. The sewage of Paris constitutes about one-fifteenth of the ordinary flow of the Seine.

Irrigation with the Sewage of Paris.

In 1869, sewage-irrigation at Gennevilliers began on a small lot of sixteen acres belonging to the city of Paris, and each year the amount of land fertilized in that way by the farmers has been increasing, as shown by the following figures:—

1869,	16 acres irrigated.
1870,	55 " "
1871,	(War, etc.)
1872,	111 acres irrigated.
1873,	221 " "
1874,	289 " "
1875,	314 " "

A difficulty was encountered here, in the fact that the land irrigated with sewage was owned by private parties, most of them farming on a few acres, and there was very little system or certainty in the purification of the sewage.

* *Conseils de Salubrité*, in many cases in France, require manufacturers to let their refuse settle in tanks before running off, thus separating and keeping out of the rivers the solid parts; but the result of such action has often been to drive them to places where their pollution of the streams would not be complained of. Even in some parts of Paris, the small streams have become quite foul.

Intercepting Sewer and Deep-Sea Outlet.

Accordingly, a plan was considered by a commission consisting of MM. Kleitz, Chatonay, Belgrand, Alphand, Mille, inspecteurs généraux des ponts et chaussées; Krantz, Vaudray, ingénieurs en chef; Calon, Depaul, ex-conseillers municipaux de Paris; Chevalier, Bonder, membres du conseil de salubrité; for conveying the filth of Paris to the sea by a sewer, more than one hundred miles long: but it was finally pronounced impracticable. Another proposition* then was to build a long sewer to follow the valley of the Seine, crossing the river four times, and, on reaching Canteleu, to be still some distance from the sea. This conduit was to be one hundred and forty-four kilometers long, of which thirty were to be covered, two were to be in siphons, and the rest open. It was to pass through four departments, and was estimated to cost ninety million francs. The sewage was to be used by the farmers as they wanted it, and little was supposed to be left to be discharged at the outlet. This plan, also, failed to get the approval of the authorities.

Precipitation.

Experiments for one year with another of the precipitating processes, after so many had failed, also met no approval with the authorities, although, as usually occurs, the company claimed excellent results. The process consisted of two long canals, to be used alternately, and of two compartments each. In the first compartment, the suspended matters were allowed to collect, as far as may be, by simple subsidence; in the second, a precipitating mixture of phosphate of lime and muriatic acid was used for further removing insoluble ingredients. The effluent was represented as looking clear, and as containing no more soluble organic matter than would be oxidized on exposure to the air. Nothing is said of the value or salableness of the sludge. The statement was made that 300,000 cubic meters of sewage a day may be treated in this

* Assainissement de Paris. Des Eaux d'Égout et des Vidanges. Leur utilisation à l'agriculture par irrigation dans leur parcours jusqu'à la mer. Mémoire à M. le Préfet de la Seine: à M. le Président et à MM. les Membres du Conseil municipal de Paris, par F. Ducuing, le Président de la Société des Études, Membre de l'Assemblée Nationale. Paris. 1875.

way at an annual expense of 1,080,000 francs, but I have not been able to find the actual amount of money expended on the trial.

Present Condition, Objections, Etc.

The city of Paris had agreed with the authorities of Gennevilliers, in 1872, to use the land for irrigation three years; and again, in 1873, another contract was made for ten years, a length of time which was then thought necessary to test the matter fully. In March, 1876, however, pressed by repeated complaints of the filthy state of the river, the municipal council of Paris voted to take into consideration a plan for utilizing the whole of the sewage of the city, by carrying it to the forest of St. Germain and irrigating—

In Gennevilliers,	1,354 hectares.
Nanterre, Rueil,	1,550 “
Carrières, Argenteuil,	857 “
Sartronville,	558 “
The Forest of St. Germain,	1,423 “
The Commune of Achères,	917 “
	<hr/>
	6,659 hectares.

Of this, the forest of St. Germain belonged to the state, and the rest to private owners, large and small; the forest was to be used for absorbing all the sewage not needed in cultivating the arable land.

A protest was at once sent from the town of St. Germain, which had something of a reputation as a health resort, signed by 2,925 persons; and the authorities of the various towns also objected. Several petitions were also sent from Gennevilliers, one of which was signed by 414 persons, maintaining that the sewage-irrigation had raised the level of the ground-water, had polluted their wells, had flooded their cellars, and had caused intermittent fever to become endemic there, beside creating an offensive odor. These allegations have been denied by commissions on the part of the city of Paris: the high level of the ground-water was said to have been caused by an inundation of the river; and Dr. Georges Bergeron, the commissioner to examine into the question of the fever, pre-

sented an elaborate report, stating that intermittent fever had been for years prevalent at Gennevilliers, never more so than when operations in irrigation were suspended by the war, and not at all increased since the introduction of sewage-irrigation. He showed, too, that the fever prevailed least in that part of the peninsula where the sewage was freely applied to the land, and most in some low, wet land which was not irrigated.

The people of Gennevilliers are not satisfied with these results, and have petitioned* the National Assembly for a commission appointed by the state, to investigate the matter. The municipal authorities of Paris, too, have petitioned the same body to have their plans approved by getting on them the stamp of *utilité publique*.

It is quite possible that the processes have not always been carried on with sufficient care, and that in some cases too much sewage has been put on the land. Even M. Belgrand, so long at the head of the Sewer Department, says, in his report for 1875, that the question of the utilization of sewage is settled, so far as the physical difficulties are concerned; the sanitary bearings of spreading three hundred thousand cubic meters of sewage over twelve thousand acres of land daily, he considered not yet settled.

As regards this matter, the following letter from M. Alfred Durand-Claye, very kindly sent in reply to our inquiries, states the whole question in a clear light. Much that he says, in a general way, of the objections of interested parties, would apply to England as well. The official and other documents,† for which we are also indebted to him, corroborate his statements.

* This petition has been referred to the Minister of the Interior and to the Minister of Public Works. The question, of course, cannot be settled at once.

† Assainissement de la Seine, par M. Alfred Durand-Claye, ingénieur des ponts et chaussées. Paris, 1875.

École des Ponts et Chaussées. Conférences sur l'Assainissement Municipal, par M. Alfred Durand-Claye, ingénieur des ponts et chaussées. Paris, 1875.

Utilisation des Eaux d'Égout de la ville de Paris. Rapports et extraits des Procès-Verbaux des Séances. Société Centrale d'Horticulture de France. Paris, 1876.

Utilisation Agricole des Eaux d'Égout. Rapport, etc., Société des Agriculteurs de France. Paris, 1876.

Assainissement de la Seine. Enquête sur l'origine des fièvres paludéennes observées à Gennevilliers pendant les années 1874 et 1875, et attribuées par les habitants de cette commune aux irrigations faites dans la presqu'île avec les eaux d'égout de Paris. Rapport par le Dr. Georges Bergeron, professeur agrégé de la Faculté de Médecine de Paris.

BOARD OF WORKS OF THE CITY OF PARIS,
DEPARTMENT OF WATER SUPPLY AND SEWERAGE,

December 9, 1876. }

DEAR SIR:—In reply to your letter of November 13, I have the honor to send you the following statements:—

The first attempts to purify and utilize the sewage of Paris were made in 1867. During the years 1867–68, a single plot of 0.69 hectare * was irrigated at Clichy, near the outlet of the intercepting sewer. . . . In 1869, works were undertaken to carry the sewage across the Seine, to the plain of Gennevilliers. In 1870, when the war brought hostile works to the environs of Paris, more than 21 hectares were irrigated with sewage. . . . During the next two years the sewage was not utilized, the bridges across the Seine having been destroyed, and the pumps having been injured by shells.

In June, 1872, when the works were ready again, not only did the farmers cultivating the 21 hectares previously irrigated return to that method of cultivation, but the irrigated area reached an extent of 45 hectares. The pumping-engines of 40-horse power, which had been thus far sufficient, failed to do the work, and a powerful engine was put up at Clichy to pump a greater portion of the sewage from the intercepting sewer; at the same time discharging some of the sewage at St. Ouen by gravitation from a reservoir. The irrigated surface was then 115 hectares.

In 1875, the distributing conduits had been extended so as to reach the whole surface of Gennevilliers; the pumping-engines were of 400-horse power, and the surface irrigated in August, 1876, was 228 hectares, now reaching about 300 hectares.

The whole of this land belongs to proprietors who use the sewage on their plots at their own expense and risk. The city of Paris provides only the main conduits; the farmers prepare all the other requisites at their own expense. The sewage is given free to all, except those who want a long concession, to whom from 25 to 50 francs a hectare are charged on agreements for 12 to 30 years. The farmers use the sewage in quantities to suit them,—on an average, 50,000 cubic meters a year for each hectare of the porous soil of the plain of Gennevilliers.

These results having appeared thoroughly convincing, and the purification of the sewage by chemical processes having been necessarily abandoned, by reason of their practical inefficiency and high cost, we have laid out the general plan designated in the map which I send to you.

* The table of the metric system is given on page 16.

The irrigation now carried out at Gennevilliers will be extended by the main conduits proposed, so as to take in the other lots, forming a surface of 6,000 hectares. The amount of sewage found sufficient being 50,000 cubic meters a hectare each year, and, the sewage of Paris amounting to 100,000,000 cubic meters a year, 2,000 hectares would be enough; but, in taking three times that amount of land, we expect to get better and more speedy purification of the sewage. The land north of the forest of St. Germain belongs to the state, and forms a large space where the conduits end, and where the sewage not needed by the farmers can be disposed of.

This project has been made the subject of examination by the authorities during the past summer, whose reports I will have the honor to send to you as soon as they are given to the public; and I will also inform you when the plan has received official sanction.

To recapitulate: from the close of the war in 1872, to 1876, the surface irrigated voluntarily by the farmers in Gennevilliers, has increased from 20 hectares to 300. The amount of sewage used annually for each hectare has been 50,000 cubic meters. This year we have used over 10,000,000 cubic meters. The chemical processes have been given up. The definite plan by which all of the sewage of the city is to be utilized, has been drawn up and submitted to the authorities.

This natural development of the system, since the city does not itself carry out the irrigation, is the best reply to the criticisms which have been made by certain persons. In a work so new, and which has already reached such magnitude, it is impossible to avoid counter-statements, often made, too, with some heat. We would not presume to say that we have avoided every kind of mistake. Indeed, by the very freedom with which we have allowed the sewage to be used, some private interests have been injured. It is clear, for instance, that the dealers in chemical reagents, and inventors of processes of precipitation, are by no means pleased to see the plain of Gennevilliers covered with irrigated fields; this free and spontaneous development of sewage-irrigation is the absolute condemnation of their inventions and systems. Hence come complaints, criticisms, articles in the papers, etc., in reply to which we offer the statements of the three or four hundred farmers who are actually using the sewage on their land.

It has been said that ill health and fevers have resulted. But an eminent physician of Paris, *professeur agrégé* of medicine, M. Bergerons, has made an exhaustive investigation of the subject. I send you a copy of his report, from which you will see that he

shows that there have been no insanitary influences from the irrigation.

Hoping that I have been able to meet your wishes,

I am, with distinguished regards,

Respectfully yours,

ALFRED DURAND-CLAYE.

Dr. CHAS. F. FOLSOM, *Secretary of the State Board of Health, Boston, U. S.*

SOME OBJECTIONS TO SEWAGE-IRRIGATION CONSIDERED.

It must be acknowledged that part of the complaint at Gennevilliers is verified by experience elsewhere. Müller, for instance, has shown* that in the beach-sand of the sewage farm at Dantzic, the ground-water contained a considerable proportion of ammonia, and had an offensive odor on standing.

Dr. Lissauer of Dantzic has made most exhaustive researches and experiments† in this subject, from which he shows that the ground-water of the sewage-farm of that city is somewhat modified by the process of irrigation, and that, therefore, all the sewage is not taken up by vegetation, but that a certain portion, even in summer (as all must in winter), depends for purification on filtration and oxidation alone. In time of storm, too, when the ground is saturated, particles of sewage occasionally pass through unoxidized, and, therefore, no wells in the vicinity should be used for drinking-water. It is recommended that trees be planted on the edges of sewage-farms, to *complete* the purification.

At Croydon,‡ "when certain fields were being irrigated, the different water-courses in the neighborhood of the field rose and discharged effluents, which went off indirectly into the Wandle; and in some of the wells attached to cottages upon the farm, in two or three instances, when the fields in the neighborhood were irrigated, the water rose, and fell when it was taken away, showing that they were affected by the irrigation," although the water has always been pure, as the experiments at Eton§ show that it is likely to be, where the soil is not so loose and sandy as to allow the sewage to run rapidly through it.

* Deutsche Vierteljahrsschrift f. off. Gesundheitspflege, VIII., 187.

† Hygienische Studien über Bodenabsorption, Frankfurt-am-Main, 1876.

‡ Society of Arts Conference, p. 69.

§ Ibid., p. 23.

“Last year, attempts were made at Eton to trace the course of the upper subsoil waters; holes were dug on the farm to the subsoil, and filled with sewage, into which was put chloride of lithium. Samples of the water from the neighboring wells, examined with the spectroscope, gave no result; holes were then dug within a few yards of the first holes, but the subsoil water from these showed no trace of lithium; it is possible, however, that the chloride of lithium may have been converted into the oxide or carbonate, and so remained fixed. The experience at Eton, therefore, rather leads one to suppose that the width and depth of the volume of subsoil water all round the farm is so great, that the effect of the sewage, so far as analytical tests are concerned, would be lost, almost directly, and that samples of the subsoil water taken on the line of its flow, one hundred yards above and one hundred yards below the farm, would not show any appreciable difference.”

At Gennevilliers, too, according to M. de la Trehonnais,—

“Sewage, containing forty-three grammes of nitrogen per ton before its application to the land, when analyzed after percolation through the soil, gave scarcely any trace of it in a decomposable state. Only 1.6 grammes of nitrogen in a state of mineral ammonia could be found. It was the same with the quantity of soluble oxygen. The sewage-water, when laid on the land, scarcely contained two cubic centimeters of oxygen per quart. On its effluence from the soil, it was found to contain from eight to ten, which is the unerring characteristic of healthy water.”

At Meerut, the water-level was found to have risen, in consequence of canal-irrigation, from fourteen feet below the surface, on Oct. 31, 1869, to nine feet seven inches at the same date in 1874; but it is expected that this will be remedied by drainage-works.*

EFFECTS ON HEALTH OF BAD DRAINAGE.

It is no new idea that good sewerage and drainage are essential to health. As far back as 1834, one of the leading medical men of London gave his evidence that four-fifths of the cases of typhus fever (probably typhoid, as the two diseases were not distinguished then) which he witnessed, he

* Report on Sanitary Measures in India in 1874-5. London, 1876.

could trace to foul drains and foul gullies; and even if, in an attempt to cleanse houses, we foul rivers, should we not ask, with one of the first living sanitarians, "Whether is it better to pollute rivers or pollute houses or towns? to kill fish or to kill men?"

Sources of Disease.

Unfortunately, the year's experience has added nothing positive to our meagre knowledge of the agencies which cause or communicate disease.

Contaminated Water.

Prof. Wanklyn thinks that the contagium of the diseases communicable by infected water are of an albuminoid character, and of such definite form, etc., as to be removed by efficient filtration. Dr. Alfred Carpenter, whose sixteen years' experience at Croydon entitles his opinion to great consideration, says: *—

"The most important operation which takes place on a sewage farm, is the destruction of contagious particles. The moment they are brought into contact with the spongioles on the rootlets of sewage-grown crops, as may be easily seen in any field of rye-grass which is being irrigated by sewage, the spongioles seize upon the albuminous matters in the sewage by a kind of elective affinity, including the contagium-particles, remove them from the water and digest them with an avidity which is most remarkable; no putrefaction takes place, no retrograde decomposition arises, but the albuminous matter is digested as perfectly as white of egg is digested by the human stomach. Putrefaction is no part of sewage-utilization, and, if putrefaction takes place, there is a corresponding decrease of productive power, and also a proof that sewage farming is not properly carried out."

The late Dr. Letheby, formerly health officer of the city of London and chemist to the Thames Conservancy Board, held the theory of the ready destructibility of disease-communicating matter, and always maintained that with proper filtering the Thames, although polluted, supplies safe water to London.

* Address on Public Medicine before the British Medical Association, 1876.

The Purist Theory.

Prof. Frankland and many others hold the opposite theory, and their position is well shown in the sixth report of the Second English Rivers Pollution Commission, published early in the year; a most exhaustive work on the water-supplies of that country, and in which the conclusions that have been reached are based upon the examination of more than two thousand samples of drinkable water.

They condemn river-water because it is liable to contamination from drainage of cultivated land, towns, and manufactories; also shallow-well water, because it "often consists largely of the leakage and soakage from receptacles for human excrement," and they recommend,—

1. Spring-water.
2. Deep-well water.
3. Rain-water.
4. Upland-water.

Of these four, "evidence of previous sewage or animal contamination is strongest in the case of spring and deep-well water; but this evidence may, in the case of these waters, be safely disregarded" (p. 425), and (p. 17) "because the prolonged filtration to which such water has been subjected in passing downward through so great a thickness of soil or rock, and the rapid oxidation of the organic matters contained in the water, when the latter percolates through a porous and aerated soil, afford a considerable guarantee that all noxious constituents have been removed."

They classify waters for domestic use thus:—

<i>Wholesome.</i>	1. Spring-water.	} Very palatable.
	2. Deep-well water.	
<i>Suspicious.</i>	3. Upland-surface water.	} Moderately palatable.
	4. Stored rain-water.	
<i>Dangerous.</i>	5. Surface-water from cultivated land.	} Palatable.
	6. River-water to which sewage gains access.	
	7. Shallow-well water.	

Among their conclusions are these:—

"Of all the processes which have been proposed for the purification of sewage, or of water polluted by excrementitious matters,

there is not one which is sufficiently effective to warrant the use for dietetic purposes of water which has been so contaminated."

"The admixture of even a small quantity of these infected discharges [of persons suffering from cholera or typhoid fever] with a large volume of drinking-water, is sufficient for the propagation of those diseases amongst persons using such water,

"The most efficient artificial filtration leaves in water much invisible matter *in suspension*, and constitutes no effective safeguard against the propagation of these epidemics by polluted water.

"Boiling the infected water for half an hour is a probable means of destroying its power of communicating these diseases."

They recommend giving up the present supplies from the Thames and the Lee, thinking that there is no hope of the "disgusting state of the river being so far remedied as to prevent the admixture of animal and other offensive matters with the filtered water as delivered to the metropolis," although the Thames is far worse than the Lee; and they say that immense numbers of the population of the towns throughout Great Britain are "daily exposed to the risk of infection from typhoidal discharges, and periodically, to that from cholera dejections."

Contaminated Air and Soil.

Virchow has concluded from his investigations,* that the level of the ground-water does not in all cases bear a definite relation to the prevalence of typhoid fever, and never unless the soil is polluted. He shows that the experience of German cities corroborates Dr. Buchanan's demonstrations with regard to England, that typhoid fever has been materially decreased by the introduction of good water and sewerage. Polluted water he considers the main cause of its spread, although he differs with most sanitarians in thinking that it is in some degree directly contagious.

Dr. Liévin, of Dantzic, after a minute investigation,† has proved that "the life-saving influence of their new sewerage-system is clearly shown."

Pettenkofer still holds to the theory that the chief agency in

* Deutsche Med. Wochenschrift, I. and II., 1876.

† Die Sterblichkeit in Danzig vor und seit dem Jahre 1872. Danzig, November, 1876.

spreading typhoid fever and cholera, is the decomposition of organic matter in the soil from variations in the level of the ground-water, allowing the virus to escape into the air. So far as Munich is concerned, he thinks that the drinking-water has little to do with the production of those diseases, although he acknowledges that some of the contagium may be conveyed as well into the water we drink as into the air we breathe.

Many authorities hold, that the "disease-germ," if there be such a thing, is not dangerous until decomposition has set in, and that it can therefore be very easily destroyed if care be taken.

Oxidation of Sewage.

It is well known that by the action of the soil, the carbon in sewage becomes carbonic acid, the hydrogen water, and the nitrogen ammonia, nitrates and nitrites; the sulphur unites, most of it, with the iron which is found in the earth. The amount of nitrogen as nitrates and nitrites is therefore considered as the chief element in the evidence of "previous sewage contamination," given in Dr. Frankland's monthly tables of examinations of the eight sources of water-supply of London; but this is evidently fallacious, for, by the returns of July and November, 1875, the purest water (from the Kent Company) is shown to be in that respect, respectively fifty per cent. and nearly two hundred per cent. worse than the worst of the river-supplies, so that the following qualification is published: "As the Kent Company's water is unpolluted, and as it is drawn from deep wells, the evidence of previous sewage or animal contamination which it exhibits may safely be disregarded"; and in the explanatory notes published each month, we find this sentence referring to the river-waters, and not especially to the Kent wells: "By gradual oxidation, this animal contamination has been, so far as analysis can show, converted into innocuous inorganic compounds before the water was submitted to investigation."

The theory of Dr. Frankland with regard to this evidence of "previous sewage contamination," is understood to be, that if there is uniformly in water what was organic matter which has been thoroughly oxidized, there may be at times some which has not been oxidized, which is too slight to be detected

by chemical examination, and which may produce disease. Sir Edmund Becket says* that the logical deduction from this "purist" theory is, that "a particle of sewage sent into the Thames at Oxford, arrives as a particle of sewage at Hampton, and may poison a man in London."

Filth not Safe.

Whatever theory of *bacteria* and "germs" proves true, the evidence accumulates each year to show: 1st. That under certain conditions human excrementitious matter in certain diseases is almost certain poison, producing the parent-disease in a great number of cases of those exposed to it, and with a degree of virulence proportional to its concentration. 2d. That we must either acknowledge that these diseases, especially cholera and typhoid fever, may arise *de novo*† under certain conditions of filth not yet wholly known, or else that the contagious matter is of extraordinary vitality, and capable of being conveyed in manners and to distances not now usually suspected.

Specific Poison Theory.

If the fact be true, that such diseases arise without the specific poison from a previous case, many epidemics may be explained which are otherwise entire mysteries; but it would be difficult to account for the dozens of cases to which many a farmer can point, where a family have for years used the water from a well close to an accumulation of filth, without apparent harm, except on the theory that the filth was not sufficiently concentrated, or that a healthy person living under generally healthful conditions is usually able to resist such deleterious influences until his system is, for some cause or other, below par.

Illustrations from Poisoned Air.

A few striking cases have been investigated during the past year with an exactness which has left little to be asked for to make the deductions appear as absolute certainties.

* London Times, January 10, 1876.

† Some striking illustrations of this theory may be found in the Brit. Med. Journal, May 27, 1876, and in Braithwaite's Retrospect, Part LXXIV.

Croydon.

So much attention has been paid to practical sanitation in Croydon, that a severe epidemic of typhoid fever, with 1,200 cases and 104 deaths, was looked upon with some alarm. Mr. Baldwin Latham, C. E., attributed it to the condition of the deep wells from which part of the water-supply was got, thinking that they were necessarily contaminated when the water was low,* but the chemists proved that the water was always pure, so far as analysis showed; and, if there were at any time sufficient impurity in any deep wells to cause disease, it was thought that frequent chemical examinations would show that something was wrong.

Dr. Alfred Carpenter, chairman of the Sewage Farm Committee, attributed the outbreak to the pollution of the drinking water by means of the intermittent system of supply,† the pipes, when empty, having become filled with sewer-gases through the valves used to flush the sewers. It was shown that such fouling of the water did occur, and in one case even the blood of a neighboring slaughter-house was drawn up into the water-pipes.

A most minute investigation was afterwards made by Dr. George Buchanan,‡ in the course of which he was able, by the coöperation of the physicians of Croydon, to locate all the cases, fatal and non-fatal, with very few exceptions.

In "Croydon Parish," the 1,164 cases occurred in 959 houses, as follows: in January, 15; February, 53; March, 79; April, 186; May, 39; June, 30; July, 18; August, 32; September, 69; October, 275; November, 94; December, 71. A few cases occurred in May, June, July and August, of which the records of location were not got. It is not possible to give here more than the results of the inquiry.

Although finding that, by an intermittent supply, a certain number of cases of typhoid might have occurred through contamination of the water, Dr. Buchanan says, "I satisfied

* Minutes of the Proceedings of the Institute of Civil Engineers, Vol. XLV., pp. 74 *et seq.* London, 1876.

† Sanitary Record, November 27, 1875, pp. 391 *et seq.* Also London Times, December 25, 1875.

‡ Report of the Medical Officer of the Privy Council and Local Government Board. New Series, No. VII., pp. 40-71. London, 1876.

myself that in a very considerable majority of the Croydon houses that have had fever, drain-air, charged with infection from the common sewers of the town, has had the opportunity of entering the houses," and this sewer-air "was, throughout 1875, charged to an intense degree with the infection of enteric fever." To this condition he attributed the epidemic.

An interesting fact brought out during this investigation was, as had indeed already been shown elsewhere, that the presence of sewer-gas was indicated in some cases by a slight noise as it escaped from an aperture in the pipe, even when there was no smell. How far and when such gas may be nocuous or innocuous we are not yet warranted in saying positively; but all such cases should evidently place the benefit of the doubt on the side which is safest.

Fever at Fort Cumberland.

In another case, a severe epidemic of sixty cases of enteric fever, with four deaths, was fairly traced to sewage-contaminated air breathed,* but there appears no statement whether this air was especially infected from other cases of fever or not. The facts are these. A large number of troops were stationed at Fort Cumberland at the harbor-entrance, and close to flats bare at low tide. The sewage of Portsmouth had usually been discharged at ebb tide, but, having recently been pumped into the harbor on the flood, a large amount was deposited on the mud banks near the fort, and to this the fever was clearly traced upon inquiry. The troops were all removed, the evil was remedied, and the epidemic ceased.

Fever at Uppingham School.

In the summer of 1875, typhoid fever broke out in a school of four to five hundred boys at Uppingham, England, and in the autumn several died.† The school was dispersed November 2, and its sanitary arrangements were carefully examined by Mr. Tarbotton, the local engineer, and Mr. R. Rawlinson, C. B., who suggested the proper remedies; but before these

* Public Health, London, November 27, 1875, pp. 713 and 714.

† London Times, March 17, 1876.

were carried out, and, contrary to the advice of the health officer, the school was reassembled in the following January, when the fever reappeared and the occurrence of four cases demanded that the scholars should again disperse. Mr. Rogers Field, sanitary engineer, of London, was then engaged to prepare plans suggesting the proper remedies, which he at once proceeded to do. He found the sewers too flat in some cases and insufficiently cleansed; the main discharge was into tanks at the sewage farm, which were sometimes emptied at long intervals, thus allowing the sewage to accumulate, putrefy, and back up the sewers. He says in his report,* "the town is, at the present time, essentially a cesspool town," and "nearly every house has its own well, very many of which are situated near cesspools or other sources of contamination." Of the twelve houses constituting the school, he adds, "twelve drain either wholly or for the most part into cesspools," and "in ten houses, each has one or more of its wells badly situated from contiguity to cesspools or foul drains." A noteworthy incident connected with this investigation was that one of the gentlemen connected with it contracted typhoid fever from a short exposure while standing over the fouled drains, while the workmen, although longer exposed, escaped.

Composition of Sewer-Gas.

It is unfortunate that we do not know the exact components of sewer-gas, and that there are no means of ascertaining how it acts upon the system. So far as chemistry goes, the Sewer Department of Paris have shown what the concentrated gas is, which bubbles up to the surface from the sewage-beds at the bottom of the River Seine. It is probably not unlike (except in degree of dilution) what is in our sewers, and was found to be—

Carburetted hydrogen, .	72.88	Sulphydric acid, .	6.70
Carbonic acid, .	12.30	Other substances, .	5.58
Oxide of carbon, .	2.54		<hr/>
			100.00

* Uppingham Sewerage and Private Drainage. Report of Mr. Rogers Field to the Rural Sanitary Authority, January, 1876.

Polluted Water.

Two cases, forcibly illustrating the danger of pollution of water-supplies, have been brought forward during the year.

Fever from Watered (?) Milk.

The first was of an epidemic of typhoid fever which occurred at Eagley, in England, investigated by Mr. W. H. Power, one of the medical inspectors of the Local Government Board, and at Bolton (two miles from Eagley), investigated by Mr. Sargent, the health officer of the borough.

A certain small brook had been used by the operatives of a mill, so that "large quantities of fecal matter" were found on its banks and in its bed. It was known, too, that one of the workmen was ill (it was thought that there was a possibility of the disease being typhoid fever). This brook had formerly been used, a couple of hundred yards below, for domestic purposes, but had generally been abandoned since it had become impure, although two families continued to use it, of whom one had typhoid fever, and the other (who boiled it before use) escaped. This same water continued to be used at a dairy (A), and was the only supply there. Although there was no positive evidence that the milk was diluted with it, it was acknowledged that the milk-cans were washed in it.

The outbreak of fever occurred at the end of January, 1876. From January 30 to February 5, there were one hundred and three persons attacked; from February 5 to February 9, there were twenty-eight persons attacked; from February 9 to February 15, there were fifteen persons attacked, and the epidemic declined. The cases were distributed as follows:—

TABLE XXII.

No. of families supplied with milk from Dairy A.	Of whom were attacked.	No. of families supplied from other dairies.	Of whom were attacked.	No. of families not taking milk.	Of whom were attacked.
57	55	244	7	17	1

Of the eight not supplied from A, seven drank milk from Dairy A in other houses than their own; the eighth became ill in April, was not seen by a medical man, and is not certainly known to have had typhoid fever, although so reported. The milk was represented as having a sediment after standing, and as being of unpleasant taste and smell.

In Bolton, there were fifty families attacked, of whom forty-seven were supplied with milk from Dairy A, and Mr. Sargent says, "Not one household to which the milk was traced, did I find entirely free from the disease."

The coincidence of the disease in the two places is quite striking :—

TABLE XXIII.

	IN EAGLEY. New Cases.	IN BOLTON. New Cases.
For the week ending January 22, there occurred,	2	1
29, " "	6	9
February 5, " "	123	77
12, " "	37	16
19, " "	14	7
26, " "	8	5
March 4, " "	5	29*

The water used at the dairy (from the fouled brook) was analyzed by Mr. Sargent, and also the drinking-water of Bolton for comparison, with the following results in parts per 100,000 :—

TABLE XXIV.

	Bolton Water (pure).	Eagley Brook.
Free ammonia,	0.001	00.20
Albuminoid ammonia,	0.006	00.26
Total solid residue,	7.910	193.00
Organic or volatile,	2.860	121.50
Chlorine,	3.580	128.80

* Many of these were supposed to have been infected from other sources, as might easily have occurred so long after the outbreak, in a crowded community.

Enteric Fever at Lausen.

The second occurred at Lausen,* Switzerland, in 1872, but has been referred to quite often of late, and is especially interesting, as proving, in a marked degree, the direct poison-like action of typhoid dejections, even when very much diluted, illustrating the apparent immunity with which impure water may often be drunk if not specifically contaminated, and because the case has been generally used by the reporter and others † to prove what the facts by no means warrant; namely, that the contagium of typhoid fever is not separable or destructible by efficient filtration so as to be harmless. The fact may be so or not, but it can hardly yet be said to be proven; and it is quite significant that the late Dr. Parkes, in referring to this outbreak, fails to make any mention of this particular point.‡

The facts are these. In a house, A (see sketch on page 125), a man became ill of typhoid fever, June 10, 1872, and recovered in September; a second case occurred July 10, ending in recovery in October; and in August there were two others, mild and of short duration. The Furlen Brook was contaminated with their dejections.

From the middle to the last of July, as was done each year, the land, C, was irrigated by diverting the stream over it; and the water in the public well of Lausen, D, became so turbid and foul-tasting, that many people gave up using it. This well distributes its water through the wooden aqueduct, E, to the four public pumps marked by round dots; it is also at the junction of two quite small streams, one flowing from the south-west and the other from the south-east.

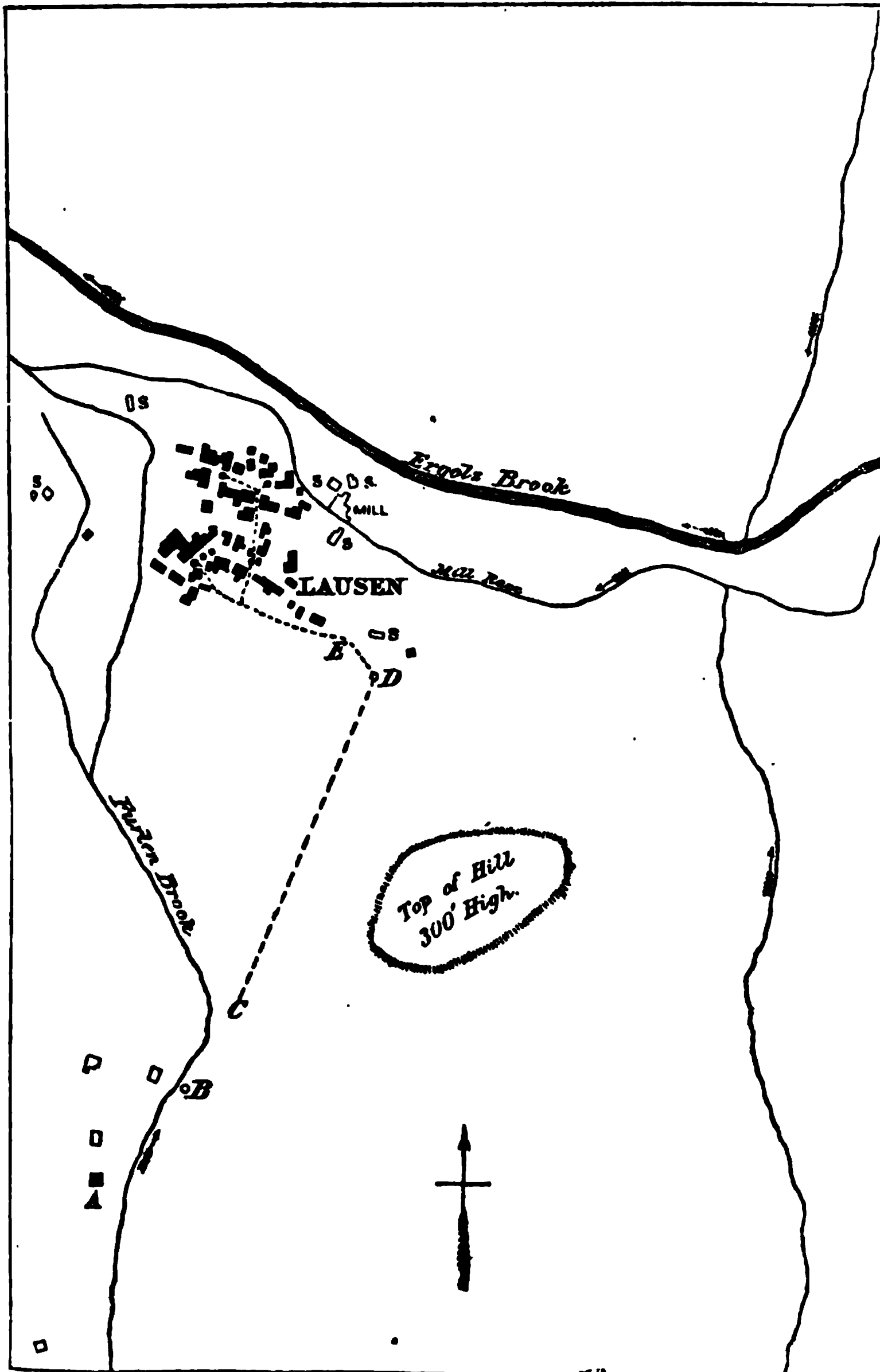
In Lausen, a village of seven hundred and eighty inhabitants, in ninety houses, standing on gravelly ground, from thirty-five to sixty feet above the level of the Ergolz and of the ground-water, there had been no epidemic of typhoid fever since its occupation by soldiers in 1814, and not a single case since 1865, when a few were imported from Basel.

* Deutsches Archiv für Klin. Med. XI., pp. 237-267.

† The Lancet, London, July 15, 1876. Journal of the Chemical Society, June, 1876. Sixth Report of the Rivers Pollution Commission, p. 463, London, 1876 (referred to on page 115 of this Report). Deutsche Vierteljahrsschrift, f. off. Gesundheitspflege, VI., 154.

‡ Army Medical Department, Report for 1873, London, 1875.

The first case in the epidemic to be described was thought to have been imported, as the victim of it had been away from home during the probable period of infection.



MAP ILLUSTRATING THE EPIDEMIC OF TYPHOID FEVER AT LAUSEN.
[Deutsch. Arch. f. Klin. Med.]

On the 7th of August, 1872, ten persons in Lausen were attacked with typhoid fever; from the 7th to the 16th, fifty-seven; from the 7th to the 28th, one hundred; in September and October, thirty, when the epidemic ceased. Of the one hundred and thirty cases, eight died; and beside these, about a dozen children were attacked, who were spending their holidays in Lausen.

There had been no known communication between the house, A, and Lausen. The six houses marked S are supplied with their own private wells; in them only two persons had the fever, and they had drank the public water away from home. All who became ill had used the public water, and the cases were distributed among all classes and conditions; of those who drank other water only, none had the fever.

After excluding all other sources, it was thought by Dr. Hägler, who investigated the case, that there could be no cause of the disease except in the public well, D.

If the contamination had come from the numerous privy-vaults, there seemed no reason why the six houses marked S should have escaped. It is unfortunate, however, that this bearing of the question was not more fully investigated, especially as the soil was very dry, the ground-water standing more than thirty feet below the surface, and as exceptionally heavy rains in May, July and August had caused great temporary changes in the condition of the soil. Dr. Hägler says, too, that the people were less neat in their habits than the inhabitants of the neighboring city of Basel.

In 1862, a portion of the earth, marked by the dot at B, had fallen in, forming a hole eight feet deep and three feet wide, and having at its bottom a running stream which appeared to be fed by the Furlen Brook from a point higher up. When the brook was let into this hole, the water all disappeared, and in an hour or two "streamed out" at the well, D, showing a connection between the two that had been suspected for years. The hole was then filled up, and the brook returned to its bed.

The infected house, A, was about a mile from Lausen; and it has been seen,—

1. That the Furlen Brook was contaminated with typhoid dejections in June, July and August.

2. That the contaminated water was used to irrigate the land, C, for the three weeks preceding the epidemic in Lausen.

3. That this irrigation-water, fouled by dejections, so polluted the well, D, as to make the water offensive.

4. That this water could not have been filtered, in any sense of the word, before reaching D, as it was turbid and foul enough to make many people give up the use of the well.

On making the investigation, some weeks after the epidemic, the hole, B, was reöpened as nearly as possible in the old place. A large quantity of salt was thrown into it, and its presence at D was soon ascertained by chemical examination. Then a considerable quantity of flour was put in at B; but its presence could not be detected at D.

Dr. Hägler's theory is that there is a communication between the Furlen Brook and the well, D, which allows water to pass through, but that it is efficiently filtered in its passage; and that the "germ" of typhoid fever may pass through nearly a mile of gravel, so complete a filter as not to allow flour to pass it, and yet be still an active disease-producing organism.

We cannot doubt, in the face of the evidence, that when the land, C, was irrigated there was abundant opportunity to foul the well, D, with the excreta of persons suffering from typhoid fever; but the facts do not prove the indestructibility of the contagium of disease by efficient filtering.

To make the conditions of the experiment correspond with the actual conditions, the salt and the flour should have been put directly into the brook, or upon the land, C, while allowing the brook to run over it.

Yellow Fever and Filth.

In the city of Buenos Ayres, during the year of the cholera epidemic (1867), one-twentieth of the population died; in 1871, the yellow-fever year, more than one-tenth perished, even counting the 60,000 who fled from the town. There has been a careful investigation of the causes of this fearful mortality, and filth has been shown to be so far responsible for it, that a distinguished English engineer has been engaged

to carry out a complete system of sewerage and water-supply. In the language of the report,* "the works of drainage and sewerage, so actively prosecuted at the present time, are destined to radically remove this infection, which experience has demonstrated to be one of the most fruitful causes of disease and death."

During the past year, Savannah has had a similar experience, and very largely at least from similar causes.

An investigation† into the causes and conditions of yellow fever in the United States, with the help of the library of the Surgeon-General at Washington, and a personal experience of over two thousand cases, concludes, that nothing is so important in the prevention of yellow fever as proper water-supply and sewerage. The writer farther says that the disease "cannot be taken in a pure air from persons, clothing, trunks, or black vomit; but in an impure air, other things being suitable, it can be taken from *either*."

Dysentery and Fever from Filth.

In the State Reform School for Western Pennsylvania, an outbreak of dysentery and typhoid fever affecting two hundred and seventy persons, or *ninety per cent.* of the inmates, has been investigated by a committee of the Allegheny County Medical Society.

They conclude that it was due to poisoned drinking-water. It seems that the main water-pipe got its supply from a point in the Ohio River two hundred and fifty feet from the shore, and a little below the outlet of the sewer from one of the privies, which, however, was close to the shore; and the water was often so shallow that it was possible to walk out on the pipe to within fifty feet of its end. The privy was flushed twice a day, forcing out a large quantity of heavily polluted water. This seemed sufficient to the committee, after careful examination and exclusion of other suggested causes, to create all the difficulty, although they found many other insanitary conditions about the building.‡

* Vital Statistics of the City of Buenos Ayres. By G. Rawson, M. D., Delegate to the International Medical Congress at Philadelphia, 1876.

† Yellow Fever and Malarial Diseases. By Greenville Dowell, M. D., Prof. of Surgery, etc., 1876.

‡ Transactions of the Medical Society of the State of Pennsylvania. Vol. XI., Part I., pp. 147 *et seq.*

Earth Closets.

Pettenkofer's statement that earth is no better as a disinfectant than water, and that, in either system of removal, that is best which is speedy, efficacious, and least offensive, has been exemplified in the West Riding House of Correction, where, according to Dr. Ballard's report, there was "prevalence of enteric fever preceded and accompanied by diarrhœa;—infection probably spread by the use of infected earth supplied to earth-closets."*

The experiment tried at the Maryland Hospital for the Insane in using earth-closets, mentioned in the last report of the State Board of Health of Massachusetts, pp. 186–188, and adopted after \$3,000 had been expended on account of litigation for pollution of a neighboring stream, has not proved entirely satisfactory. The closets are near windows, and when the latter can be kept open and the former are well attended to, there is no serious offence in the wards. At other times the odor is perceptible to quite a distance. The use of a sufficient amount of earth is often neglected, and the waste from bath-tubs, etc., is so polluting to the stream into which it is discharged, that fresh complaints have been made. Experience here, as elsewhere, appears to show that it is almost impossible to manage earth-closets so as to be as satisfactory as rapid and efficient removal by water.

PREVENTION OF FILTH DISEASES.

In order to avoid, in as great degree as possible, the evils of accumulated filth in crowded communities, it is necessary in the first place to have good sewers. After them, good house-drains are even of greater importance, for defects there are of greater danger than in sewers; and, if properly constructed and carefully watched, they may, to some degree, obviate the evils of bad sewerage.

House-drains, especially in tenement houses, by universal experience, are apt to be badly constructed or neglected unless controlled by municipal authorities; and there is no

* Report of the Medical Officer of the Privy Council and Local Government Board. New Series, No. VII., p. 39. London, 1876.

more important matter of sanitation now in our large cities than this. In Scotland, this control is exercised in some cities with good results.

In carrying out the new sewerage of Berlin, proprietors who wish to connect their drains with the public sewers must prepare full plans, submit them to the sewer department, receive the approval of that office, and finally have them inspected and declared satisfactory before they can be used.

The best regulations have been carried out at Frankfort-on-the-Main by the coöperation of Mr. Lindley and Dr. Varrentrapp. They are given here entire, as they show *what has actually been done* in one city at least. In considering their efficiency, we are not surprised to see Frankfort placed as the first city in Germany in the bulletins of health (*la station sanitaire par excellence de l'empire allemand*).*

Conditions under which Buildings, Yards, Gardens, etc., are allowed to be Drained into the new Sewerage System.†

1. Whenever the drainage of any house, yard, etc., is projected, the owner of the property in question must, after having signed the requisite certificate,‡ furnish to the department, duplicate plans bearing the signature of the contractor, and containing a map of the locality on a scale of at least 1:2500; a ground plan at least 1:250, and a sketch of the main drain and branches with its horizontal plane on the same scale as the ground plan, and its profile at least 1:125.

The certificate and one of the duplicate plans are to be kept among the documents of the sewer department; the other plan must be always ready for inspection by the officers at the place for which it is designed.

All plans presented must contain all the works projected; the exact positions of sinks, gullies, traps, and other details; the direction of the superficial water-carriers; the positions of the rain-spouts, cisterns, privies, water-closets, cesspools, vaults, wells, pumps, and other arrangements for water-supply; also the levels of the surface where the works are projected, including the grades of the latter, the depth of the cellar, the lowest levels of the ground, and, where possible, the depth of the foundations,—all to be given by the standard grade.§

2. All drains are to be so arranged as to accomplish the most complete drainage practicable of the building and grounds. The drainage of cellars,

* La Sante Publique, November 1, 1876.

† *Bau-Amt zu Frankfurt-am-Main. Bedingungen, etc.*, [including plans and illustrations by W. Lindley, Chief Engineer, and J. Gordon, Resident Engineer.]

Das Schwemmsielsystem Frankfurts, geschildert von Dr. G. Varrentrapp, 1876.

Exposition Internationale d'Hygiène et de Sauvetage de Bruxelles. Canalisation de Francfort-sur-Mein; L'ingénieur en chef, W. Lindley, 1876.

‡ See page 133.

§ With us, the grade is usually calculated in feet above mean low-water mark. In Frankfort, the *pegel* or O is an established level marked on the Frankfort Bridge.

where this is not desired, or where it is rendered impossible by their depth, may be omitted, if the proprietor so wishes.

The method of drainage, and the materials to be used, must be approved by the sewer department.

3. The drains may be constructed of brickwork, of glazed earthenware, of tarred iron pipe, or of other approved material, and are to be connected with the main sewers by special direction. Tarred iron pipes, lead-jointed, are recommended as the most durable and safest, and, in and near the houses, must be everywhere used as prescribed, with the following exceptions. Earthenware pipes are permitted within and without houses, if bedded in concrete whenever they lie deeper than the cellar floor, or not less than one meter from the nearest cellar-wall; within the house they must be encircled with a layer of concrete at least ten centimeters thick, and have their upper surfaces at least one-half a meter under cover. All drains must be jointed water-tight. The highest point of any drain outside of the house must lie at least 1.30 meters below the surface of the ground. Junction of drains at right angles, whether horizontal or vertical, is allowed only on special permission.

4. Whenever a change in the position of an existing outlet of a drain into a sewer is requested, and judged necessary or permissible by the department, it must be made at the owner's expense; the work must be done by order of the department, and subject to their control.

5. In buildings whose cellars are deeper than the highest level of the river (5.7 meters above 0), all pipes whose open ends lie above this level must be separated from the cellar drains, and must be so constructed as to let their contents flow into the main sewers without obstruction, even at time of freshet; the drains for points below grade 5.7 must be shut off by flap-valves.*

6. Branch drains are usually to enter drains of larger calibre; the connection of drains of the same size with each other can be allowed only exceptionally.

7. The pipes for water-closets, yards, and stables must be not less than fifteen centimeters in diameter; for kitchens and wash-rooms, not less than ten centimeters as far as the siphon-traps, and from there onward (including traps), fifteen (inside measurement). Vertical soil-pipes, as far as they are put in new, must have a clear diameter of at least twelve and at most fourteen centimeters.

8. Rain-water spouts must be of at least ten centimeters inside diameter, and be carried underground into the sewers.

They are to be of iron, with cemented joints from a point at least two meters above ground, and the lower ends must be joined by cement to the first joint of the earthenware drain by a curved pipe, also of iron.

9. Wrought-iron pipes are to be tarred inside and out while hot. Straight pipes, when used, are to have as few joints as possible; arms for branches must be long enough to allow proper junctions. . . .

10. With a uniform inclination of more than 1:20, the grade of a main drain or of a rain-water pipe may be broken; but it is stipulated that the least fall must, as a rule, reach 1:20; slighter grades are allowed only on guarantee of abundant flushing and by special permission.

* These flap-valves can be screwed down securely, and not left to chance, like the "wooden plugs," for instance, used in Boston. They are accessible by being put in the man-holes.

11. Cisterns for rain-water* are to be made with overflows which must dip below the surface of the water and be also secured by siphon-traps.

12. Kitchen and other sinks are to be carefully trapped by iron or lead siphons, before entering the drain. All entering pipes must be smaller than the siphons, and be provided with fixed strainers for catching solid matters.

13. It is recommended that the pipes before entering a main drain or soil-pipe be provided with a main trap. This, to be effectual, should be outside the building, and provided with an opening for cleansing, which might be reached by a covered man-hole 0.85 meter wide. These man-holes cannot be put in the public streets without special permission.

14. All traps must have a water-depth of at least 0.07 meter, and, as a rule, must be like the patterns to be seen at the sewer department; if of different form, they must receive special approval. In traps outside of the houses, the water-level must lie at least 1.30 meters below the surface.

15. Complete drainage of the subsoil may be got by common [agricultural] drain-pipes, or in some other effectual way.

16. The ventilation of each system of house-drainage is provided for by rain-water spouts, by special ventilation-pipes, or in other permitted ways. Rain-water spouts can be used for this purpose only when their upper ends on the roofs are not situated near or below windows.

17. No fluid substances from houses, yards, passage-ways, etc., shall be allowed to run into the public streets, but must be carried underground into the sewers after the foregoing rules.

18. Immediately after completion of a house-drainage system, all vaults must be emptied and filled with earth.

19. No old water-closets or soil-pipes can be connected with the sewers until examined and approved in accordance with the rules just given. Old drains, etc., must be made to conform to these rules as nearly as practicable; old soil-pipes, provided they are found in good condition, may be allowed to stand, even if more than 14 centimeters in diameter, or with sides less than 0.6 centimeter thick.

20. Pan-closets must have a water-trap of 7 centimeters, and be capable of such wide opening as to make the bottom of the bowl entirely free; the width of this opening shall not exceed 9 centimeters. Between the pan and the soil-pipe is a siphon-trap, with a depth of at least 5 centimeters of water, and with a clear diameter of 10 centimeters.

21. Earthenware closets [*i. e.*, "hopper-closets"] with siphons of the same or different material, are allowed, after special approval, if there be sufficient water for copious flushing.

22. Special arrangements for factories, hospitals, schools, public halls, etc., require special approval.

23. The connection of any water-closet can be permitted only when the water-supply is sufficient to completely flush all matters through the local drains into the sewers.

24. The vertical soil-pipes of all water-closets, even if small in diameter, must be carried up above the roof and beyond all windows, for the sake of ventilation.

25. No plan of house-drainage shall be approved until the proprietor has furnished evidence that these rules for the disposal of human refuse can be kept, or until others shall have been provided by the sewer department to satisfy their requirements.

* This, of course, is not used for drinking.

Form of Certificate.

The undersigned, owner of house _____, No. _____, petitions the department for permission to drain into the public sewers, in conformity with the accompanying plan, and pledges himself, for himself and heirs,

a. To pay to the department the assessments* which are made upon the proprietors by law or by statute.

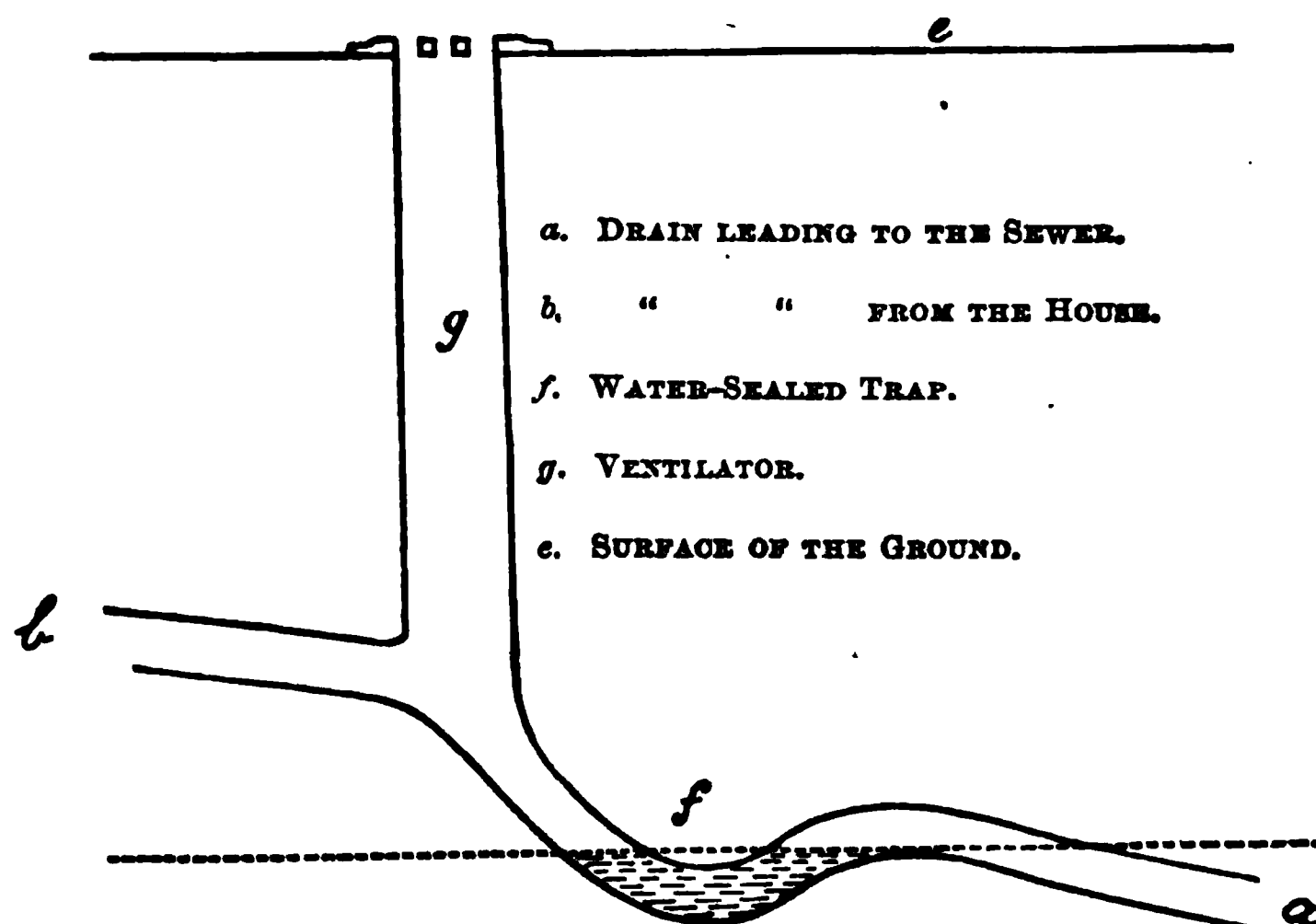
b. To construct the proper works within his house and lot, in conformity with the general and particular specifications of the sewer department.

c. To remove cesspools, vaults, etc., from his lot, according to directions of the sewer department, immediately after completion of the drainage-system.

After the Croydon epidemic, Dr. Buchanan recommended that the sewers be entirely disconnected from the houses by traps, and also by vents, in the manner described in the accompanying cut. (Fig. I.)

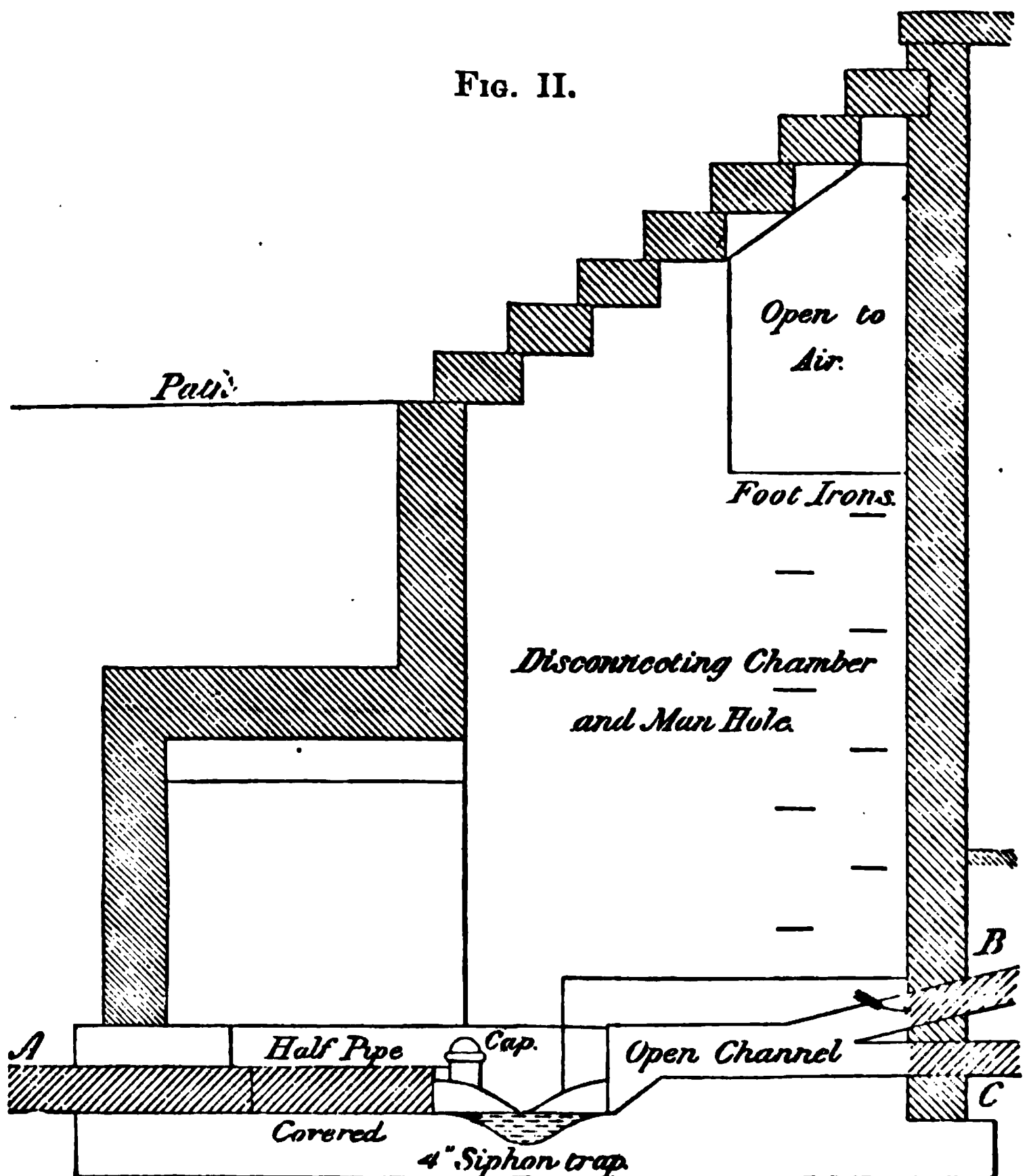
If a man-hole were built instead of the small air-passage, ready access to the drain and trap might always be had; and, in our made land, this would supply a common defect by which early knowledge is not now got of the breaking of pipes by settling of the soil.

FIG. I.



* Or, as we say, "betterments." No one in Frankfort is compelled to adopt the water-carriage system and connect with the sewers; but, if they do so, they must follow the rules. The number of houses for which drainage-systems were completed, was, in 1872, 885; in 1873, 1,345; in 1874, 1,960; in 1875, 2,908.

Figure II. illustrates the same principle as carried out by Mr. Rogers Field of London. In both cases the draught is downward through the ventilator, the air passing out through the soil-pipe over the roof. These ventilating-shafts might not be available for the whole year in our climate, but freezing could easily be prevented by packing in winter.



A represents the drain leading to the sewer. *B* is the lower end of the soil-pipe. *C* is formed by two drains,—one from the kitchen and flush-tank, and the other an agricultural tile for draining the soil.

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The disconnecting chamber is placed under the stairs passing from the rear door of the house to the garden. The "open channel" (see also Fig. III.) is simply a half of a drain-pipe with its upper part entirely open, and would be represented in cross-section by a letter U. In this way, any sewage-exhalations that pass the syphon-trap are diluted and diffused in the open air, while a nearly constant circulation is produced through the whole length of the soil-pipe and out over the roof. There is no odor perceptible from the open channel.

It should be distinctly understood that carrying the soil-pipe through the roof should never be used as a means of ventilating the sewers; it is simply for ventilating the system of house-drains, soil-pipes, etc.

In Figure III., a detailed ground-plan is shown of Mr. Field's very thorough system of house-drainage.

A represents a double ventilating-shaft, about ten feet high. *B* is the flush-tank* for collecting kitchen-grease, etc. The disconnecting chamber and man-hole are represented on a large scale in Figure II. If it be said that such precautions indicate an excess of care, it should be remembered that many persons are unwilling to leave a stone unturned, especially where there are children or delicate persons, to have the sanitary arrangements of their houses as nearly perfect as possible. Without these, or equally effective measures, it can be hardly considered safe to have wash-bowls, bath-tubs, etc., in direct communication with rooms which are constantly occupied.

Of course, it is not intended that this report should convey the meaning that good sewerage and good house-drainage are the panaceas for all our fevers, etc., etc. But they represent one of the most urgent sanitary needs of many of our cities, public buildings, and residences at the present time. Personal hygiene must indeed supplement laws protecting the public health, but without them, in many cases, no care on the part of individuals can save them from fatal diseases.

Very few States, unfortunately, recognize their responsi-

* The "flush-tank" has been described by Mr. J. Netten Radcliffe in the Second Report of the Medical Officer of the Privy Council and Local Government Board of England, pp. 230 *et seq.*, and by Colonel Waring in "The Sanitary Drainage of Houses and Towns," pp. 199 *et seq.*

bility in this matter; but it is to be hoped that the time is not far distant when we can realize the prediction* of Dr. Benjamin Rush, the most noteworthy physician that our country has produced. Many years ago he said that the means of preventing pestilential fevers "are as much under the power of human reason and industry as preventing the evils of lightning and common fire. *I am so satisfied of the truth of this opinion, that I look for a time when our courts of law shall punish cities and villages for permitting any of the sources of billious and malignant fevers to exist within their jurisdiction.*"

In our large buildings, hospitals, asylums, hotels, etc., there is too often a lamentable deficiency of foresight and care in these respects. The general principle, so admirably carried out by Dr. Cowles in his recent work at the city hospital of Boston, to keep soil-pipes, water-pipes, drains, etc., as accessible as possible, where they may be seen at any time, cannot be too strongly recommended.

The cost of sanitary improvements, as compared with their value to the community, does not come within the scope of the present paper; but the whole matter has never been better stated than by the Army Sanitary Commission, that "the sooner the idea that stations are unhealthy because they are unhealthy is replaced by the conviction that an unhealthy station represents an annual loss far greater than the cost of improving it, the more certainly will striking differences in local statistics be equalized."

* Essay on Summer and Autumnal Diseases.

SEWERAGE:
ITS ADVANTAGES AND DISADVANTAGES, CONSTRUCTION AND MAINTENANCE.

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SEWERAGE: ITS ADVANTAGES AND DISADVANTAGES, CONSTRUCTION AND MAINTENANCE.

Before determining what plan or system of sewerage, if any, should be adopted for a city or populous district, the question should be asked, and, in fact, always is asked by the tax-payers, of what benefit would the system be if carried out? To answer this question intelligently requires a knowledge of sanitary laws in general, and of local peculiarities, including topography, population, business, and legislative action, both had and obtainable; also, quite often, of the physical and industrial characteristics of the surrounding territory.

Sanitary laws, in general, include subjects which can be properly investigated and explained only by the medical profession, because the members of it alone have the necessary training and means to do it in a thorough manner. Nevertheless sewerage, as a specialty, is and must be studied and applied by individuals especially qualified. Local peculiarities relative to topography, population, business, etc., can be obtained only on the ground.

The most satisfactory, and generally convincing, arguments in favor of sewerage are those obtained from an experience sufficiently extensive as to time and population. Bills of mortality are appealed to usually, and, with the exception of a few anomalous cases, susceptible either of remedy or satisfactory explanation, show, both for European and American cities, a very favorable result. It cannot reasonably be expected, however, that a city or town whose mortality has been decidedly diminished by the construction of sewers, even when combined with an abundant supply of pure water, should continue to show, decade after decade, diminished death-rates. Just the reverse of this often happens; sometimes from defects in the sewers or their maintenance, or in the house-connections, but oftener from evils connected with the industrial,

hygienic, social, or moral habits of the people, or from climatic causes.

Sometimes the character of the population of large districts in cities changes greatly in a short time. In such cases, there may be a large increase in the rate of mortality, without any change whatever in the sewerage system or its maintenance. There may be no change in the population or sewerage, yet materials used in the construction of buildings may become, by absorption or decay, deleterious to health. Districts originally healthy, and still properly cared for by their own local officers, may be rendered unhealthy by injurious trades or occupations outside of their limit, by deterioration and adulteration of articles of diet, and by many other causes of injury to health, which might also be mentioned. To eliminate the effect of all or any of these from that of sewerage, would be extremely difficult, if not impossible.

Death-rates should not be appealed to alone in reference to the benefits of sewerage. Should these remain the same, increased cleanliness and comfort conduce to a higher order of civilization. To fully appreciate this, one must witness the changes made, in densely populated portions of a city, from the old privy and cesspool system to that of modern sewerage, accompanied with an ample supply of water. Any serious attempt to compel such communities to return to their old methods of disposing of refuse would be met with most determined opposition, notwithstanding the views of some men, eminent for scientific and other attainments, who condemn the whole system of modern sewerage, especially water-closets and the removal of excreta by water-carriage. That their objections have force, cannot be denied; but the difficulty is, that they have never been able to devise and carry out, for densely populated districts, anything better than, or as good as, what they condemn, in a climate like that of the northern portion of the United States.

Whether modern sewerage should be applied to any but densely populated districts may very properly be questioned. So long as the ordinary dwellings of a district are widely separated from each other, or clustered in small villages only, it is practicable to preserve and promote the public health without public sewers by removing all refuse, before fermentation

or putrefaction, to the land, and there using it as a fertilizer. Unfortunately this is not done in many cases, but piles of filth on the surface are allowed to accumulate and corrupt the air ; or leaking cesspool after cesspool may be sunk into the ground and pollute the wells, engendering debilitating and often fatal diseases. But it would be superfluous to add to what has been said already under so many heads, particularly in the last annual report of the State Board of Health.*

Could the future of towns and cities be foreseen from their commencement, much might be done in laying them out to facilitate their proper sewerage ; but actual experience shows that sites selected for large cities have, in the end, very seldom been so occupied.† Any attempt to introduce into a small town a system of sewerage that would be adapted, as far as it went, to the wants of a large city, might be an intolerable burden. The question, then, of adopting such a system must be left, as a rule, until the necessity for it becomes manifest.

When the necessity for sewerage in any district has become evident, the authorities should appoint, from among their highest representative men, a commission to investigate the matter with the aid of the best engineering and other talent they may be able to procure, and prepare a plan to recommend for adoption. There may be, and are, cases where populous districts suffer greatly for the want of proper sewerage and sanitary arrangements, and yet the fear of taxation or unreasonable prejudices will oppose the carrying out of such measures. To meet such cases there must be an exercise of the power of the State, either through a board of health or some other duly authorized body. The plan recommended should be publicly discussed, so that the community may have sufficient opportunity to point out its defects, if any exist. When perfected, it should be given either to the commission first appointed, or to another like it, with full powers to carry it out. The commission should be appointed for a term of years suffi-

* See pp. 184-190, and also p. 535 (Beverly), p. 539 (Hadley), and p. 542 (Newton Lower Falls).

† The report of the Sanitary Commission of Massachusetts for 1850, p. 153, contains the following : " We recommend that, in laying out new towns and villages, and in extending those already laid out, ample provision be made for a supply, in purity and abundance, of light, air, and water ; for drainage and sewerage, for paving, and for cleanliness."

cient to complete the work, as far as needed at the time, and not be subject to change by the city council or public election during that term, except for incompetency or dishonesty. The plan, after being partly carried out, ought not to be so changed or modified as to impair its efficiency, which might happen, if new men should be placed in charge of it. Nothing is more disastrous to public works than making them subject to the control of political partisanship, so liable to be associated with municipal venality. Cases could be mentioned where millions have been squandered, appropriations exhausted, and the people obliged to do without much-needed improvements, for the completion of which they had already been taxed enough, or were loaded with bonded obligations more than sufficient.

The proper organization of the body, by whatever name it may be called, for carrying out sanitary works, is of vital importance to their success. Parsimony in this connection may prove almost, if not quite, as fatal as dishonesty. Inferior commissioners or engineers are likely to prove very costly in the end, however small their nominal salaries may be.

Supposing the organization under which the works are to be planned and carried out is what it should be, it would seem almost useless to point out further how the sewers should be planned and built, or attempt to give complete rules for every case that might occur. As in really or supposed dangerous attacks of illness, non-professional people do not begin to consult books, or send their neighbors to inquire of those who have had apparently similar diseases, but rather send in haste for an experienced physician, whose education and practice qualify him to say what should be done; so should cities and towns, through a judiciously appointed commission, employ thoroughly trained and experienced sanitary engineers, wherever they may find them, at home or elsewhere, and not attempt to get the necessary knowledge by simply consulting books or sending out committees to visit other places. This is all very well, as far as it goes, but a fatal mistake may be made by going no farther. Such committees sometimes return, feeling confident that they know how to plan and carry out such works without further professional aid, but the community finds out after a few years that it has

been educating men at a cost vastly greater than that for which thoroughly competent experts could have been employed.

With the foregoing caution against committing the responsibility of planning or carrying out sewerage-works to unskilled and untrained hands, the principles and rules that should control such matters will now be taken up.

SURVEYS.

In order to devise a judicious plan of sewerage, it is necessary first of all to know the shape, extent and topographical features of the city to be sewered. To this end careful surveys should be made, including not only the streams, canals, roads, railroads, streets and buildings (in a general way), but the heights of ground above some common base or plane of reference. Where valleys or water-sheds lying outside of the city or town must be drained through it, their shape, extent and topographical features should be known.

Beside this information, it is necessary, in order to estimate the cost of such works, and consequently to plan them wisely, to know the character of the soil as far down as it may be necessary to put the sewers. If the place should not be situated on some stream or large body of water sufficient to neutralize or render innocuous the sewage at once, the surveys should be extended to such natural or artificial outlets as the vicinity may afford. Various plans for meeting this serious difficulty are often presented for the same town; for all of these, surveys should be made.

In obtaining local information for such purposes, the engineer will often be annoyed with ridiculous suggestions, but he should be careful to treat kindly and respectfully those who make them; for, if out of a hundred recommendations, one should be of value, it would repay the trouble of listening to them all. Other things being equal, that engineer who listens respectfully to the suggestions or criticisms of the humblest individual, and profits by them when he can, is the least likely to grieve over serious faults in any part of his work.

PRELIMINARY STUDY.

A thorough survey having been made, the information thus obtained should be shown on a map sufficiently large to make

everything plain. On this map should be drawn contour lines; that is, lines showing different levels of the surface of the ground above the common base. For very flat sites the difference of level shown between the different lines should be very small,—sometimes not over two feet; sometimes a contour line for every ten feet is quite enough.

A knowledge should be had also of the past rate of increase of population, and of the reasons why it should increase at an equal, or less, or greater rate in future, together with the direction in which that increase is likely to take place, and the existing and prospective kinds of industry for which special sewerage provisions should be made.

The engineer should also know what general or special legislation bearing on the subject may exist, so that his plan, when perfected, however good in itself, may not have to be rejected, in whole or in part, on account of legal objections.

With the above information before him, the engineer begins the study of his plan, which should, when carried out, certainly accomplish not only the purpose intended, but do so for the least possible cost consistent with efficiency and durability.

As no two cities are alike in all respects, the peculiar features of each one to be provided with sewers must be carefully studied and taken advantage of. First of all, the natural water-courses, or existing drainage, should be interfered with as little as possible, except to improve them. These natural water-courses, which, within the limits of a city, are likely to become exceedingly offensive and dangerous to health by receiving ordinary sewage, can often be used to carry off excessive storm-water without any such danger, and thus permit a great reduction to be made in the sizes, and consequently in the cost, of the principal sewers. The public authorities should never permit a natural water-course to be so interfered with, as to materially diminish its flowing capacity. The temptation to do this is very great, especially where streams or ravines cross city lots in such a manner as to make it difficult, if not impossible, to erect desirable buildings upon them. The influence of property-holders with city councils in this respect is sometimes exerted to a most injurious extent. Unfortunately this mischief may be, and has been, done before the

community have become convinced of the necessity of sewerage.

It often happens, especially in large towns, that sewers have been constructed from time to time in particular localities to meet special wants, without any regard to a general system for the whole municipality, or, in fact, without reference to the natural drainage of the whole of the particular district in which it is made. London in former years presented some striking instances of this kind; but as the Londoners did not know how rapidly their city was to grow, so has it been with smaller communities since. The engineer must study carefully the plan and condition of such existing sewers; and, though he may find none of them such as he would recommend, had the work to be done anew, he may, under all the circumstances of the case, find it not only possible, but advisable, to incorporate a greater or less proportion of them in his general plan. In such matters, there is much room for discretion, and the best of engineers, as well as other experts, may differ as to what should be done. The mere cost is too apt to decide such questions, but should not do so, especially when old sewers have been badly planned or constructed.

The most perplexing problem to be solved is often that of determining upon the position of the outfall of the whole system, partly because this depends also upon the disposal to be made of the sewage. The disposal of sewage having been treated so fully and thoroughly in the last or seventh annual report of the Board, and there being no more recent experience of importance to add, it is not proposed to enter upon any discussion of the subject here. Supposing that, in the light of such information, the method of disposing of the sewage has been determined upon, the course of the main outfall sewer is then to be fixed. Ordinarily this is limited by the character of the ground, and by the streets and other improvements. Sometimes much study is required to choose judiciously between different lines on which careful surveys and estimates have been made.

The course and general character of the main outlet sewer cannot be in all respects satisfactorily arranged, particularly its upper portion, without determining at the same time the leading characteristics of the principal branches and laterals.

In order to fix these, the whole territory embraced by the plan should be divided into sewerage districts. Sometimes the natural surface of the ground is so marked by ridges and valleys as to leave no doubt about the limits of these districts. In some cases, especially on very flat ground, there will be opportunity of having large or small districts, as circumstances may require. If the districts are made very large, in view of future wants, the burden upon the present tax-payers may be intolerable. This will depend very much upon the laws and ordinances governing such matters. If the property-owners have to pay one-half or two-thirds of the cost of the sewers in their districts, when they are constructed, and if the remainder must be paid by general tax in the same years, then the burden will be very heavy, especially if large sewers are made with reference to future wants. On the other hand, if the present only, or mainly, should be provided for, the future may demand such additions as would be difficult to introduce without considerable sacrifice of old work. The saving of interest, however, would in many cases more than balance this sacrifice.

To illustrate the difference between present and future wants in constantly growing cities, let us suppose one to be situated on a large river or water-front, with a very flat site, and extending back from the water but a short distance. In such a case, no large sewer need be constructed at first, unless perhaps for storm-water; but, as the city grows, sewers of larger and larger outlet will be required, because new territory will be constantly drained into the same outlet. To avoid the expense of large sewers at first, there may be an arrangement in the plan for constructing them afterwards on every fourth, sixth, or other street, by making such street a boundary between two original districts. By laying pipe-sewers on each side of the street, as near as practicable to the curb, the centre of the street might afterwards be occupied by a large sewer, which could be constructed without rendering useless, or even endangering, any of the original work, or impairing its efficiency. But to provide with certainty for the wants of the future, requires a prophetic mind possessed by very few, if any. Still, it is necessary to make the best provision we can, and if those who come after us smile at our failures, they

will but repeat what we sometimes have occasion to do in reference to our predecessors. Imperfection of results in such cases is generally, if not always, much better than no attempt at all.

If the circumstances of the place should be such as to make pumping necessary, in order to dispose of the whole or a part of the sewage, much may be saved in annual cost of maintenance by intercepting sewers, where the ground admits of them. Such sewers are usually intended to carry off the ordinary daily sewage, and to convey, besides, a small amount of rain-water, say one-quarter of an inch, over the whole territory drained, in twenty-four hours. An excess of storm-water above this is allowed to flow over weirs provided for it on the sides of the intercepting sewer, by the shortest channels, into some natural water-course or sea or lake.

Occasionally, such sewers have to be taken across valleys of greater or less depth, and over or under rivers and canals. These are generally passed by making inverted siphons beneath the beds of the rivers or canals, and, sometimes, on the bottoms of the valleys. Such siphons, when properly constructed, and with ample means of flushing them, have been tried in European cities, and found to work so well that they are now recommended without hesitation.

Where some portions of a city are much higher than others, as in London, one intercepting sewer higher up than another may be introduced to advantage, to save pumping, and, in many cases, to accommodate available sewage-farms, which are likely to be found in different directions and at different heights.

It happens, sometimes, that an intercepting, or other principal sewer will be, in some part of its course, below the bed of a stream or other body of water, into which storm-water cannot be discharged from the sewer, without artificial aid. Advantage may be taken of this for flushing the sewer, and the general plan should be adapted to it if practicable. Instances of this, as well as of all other examples of sewerage, may be found in London, the great repository of information on this subject. The cities of Hamburg and Dantzic give admirable instances of this mode of flushing.

The depth to which it may be necessary to place the sewers, makes a knowledge of the character of the soil very essential,

as already mentioned. Sometimes the most natural lines for a sewer, as regards length and depth of cutting, may be exceedingly expensive, owing to the existence of large bodies of wet and running sand or of hard rock. Sometimes the railroad tracks, along the proposed line of the sewer, prove serious obstacles to its construction, especially where it is not practicable to divert the trade and travel temporarily in another direction, and when a suspension of the use of the road, for a few days even, would be ruinous to important interests. If the franchise of the company owning the road should be such as to entitle it to damages for any interference with the use of their tracks, such interference might be a very serious matter in the cost of constructing the sewers.

If running sand should be found on a narrow street, with tall and expensive buildings on each side, and if the grade of the sewer extend much below the foundations of the buildings, there will be great danger of causing the fronts of the buildings to settle and crack. Skill and care may do very much to avoid such results, but skill and care are not always exercised, even when bargained for in the clearest terms. Neither the ablest engineer nor the most capable and experienced contractor can be everywhere on the work, day and night. Sometimes the carelessness or absence of a foreman, or the unfaithfulness of a single laborer, will be the cause of very great damage.

The removal of rock, especially of the kinds that require blasting, may be not only very expensive in itself, but the cause of serious damage to persons and property, if not done in a very skilful manner. While it is nearly if not quite universal to make the contractors, who do such work, responsible for all the damage they cause, no agreement of the kind can release the corporation from liability to pay such damages. The contractors, if any, may be compelled by the courts to indemnify the corporation, but courts and juries do not always decide in favor of corporations. These things are said not to discourage the construction of sewers, wherever they may be essential to the welfare of a place, no matter what the nature of the ground may be, but to show what should be taken into account, in the comparison of different plans, or in different modifications of the same plan.

WHAT SHOULD BE ADMITTED INTO THE SEWERS.

No rule with regard to this subject is equally applicable in all places; for it would be not only safe, but expedient, to admit more in some than in others. A city with sewers of steep grades and an abundant supply of water for flushing purposes, and situated on a stream of sufficient dimensions and velocity, may admit into its sewers anything ever considered proper and removable by water-carriage. In such cases a great deal of road detritus may be admitted, provided it should not be so heavy as to wear away the bottoms of the sewers. When a city has sewers of slight inclination, with a scant supply of water, and is obliged to pump up the sewage, or otherwise dispose of it with great difficulty, it becomes necessary to admit into them only such substances as are easily held in suspension or dissolved by water. In no case, however, is it desirable or advisable to permit slaughter-, packing-, or rendering-houses, soap factories, distilleries, breweries, gas works, or other establishment to fill the sewers, or cause them to be filled, with noxious gases, to such an extent that no available means of flushing, except in extraordinary cases, could remedy the evil. It might seem ridiculous to say that ashes, cinders, broken crockery, and litter of various kinds should not be emptied into sewers, if actual experience did not show that it is often done, or at least attempted. Fortunately, the choking up of house-drains usually teaches those who try it, that the practice is not only wrong, but very expensive. Street gullies have been often used in this way, but a vigilant police will soon detect the offenders. Waste steam from engines, boilers, etc., should under no circumstances be allowed to pass into public sewers.

It is a matter of great practical importance, to determine what proportion of all the rain that falls should be provided for in the construction of sewers, because the greater this proportion, the larger and consequently the more expensive must the sewers be. In some favorably situated towns of moderate size, it is practicable to exclude storm-water altogether, but as a general rule this is neither practicable nor desirable. It is usual in England, as well as in this country, to make pro-

vision for a rainfall of one inch per hour. As, in most cases, one-half, or more, of this will be absorbed by the earth or other surfaces upon which it falls, the practice is to make the sewers large enough to discharge half an inch of rain, together with the greatest amount of sewage per hour.

The above rule with regard to rainfall has been found to work very well generally in England and in the United States; but it does not suffice for the removal of storm-water in all cases, because there are sometimes rainfalls in both countries of more than an inch an hour. The surfaces of some localities also absorb a larger proportion of the rainfall than others. This depends very much upon the character of the soil, the undulations of the ground, and the extent of buildings and pavements. Steep, rocky surfaces absorb very little, and instances are known of heavy rainfalls upon them doing enormous damage, where the natural water-courses had been filled up, and covered sewers, large enough, according to the usual rules, substituted for them.

SOIL-WATER.

The lowering of soil-water is looked upon as of vital importance in many cities. Where brick sewers are used, this is generally effected, though the joints of the masonry may be laid close with cement. Vitrified-pipe sewers alone do not produce this effect when the joints are made with cement, but the frequent occurrence of man-holes, catch-basins, and deep cellars leaves little or nothing to be desired. In some cases, where other provisions have been made, they have been found unnecessary.

FLOODING CELLARS, ETC.

In order to get rid of the danger of flooding basements and cellars by storm-water, some have recommended the use of tide-valves for buildings, such as are very common in the warehouses on the wharves of Boston; but, as such an arrangement may not be required to act for years, where there is no tide, it is liable to be forgotten and out of repair when needed. It is therefore an uncertain remedy.

When the soil is very dry and porous to below the bottoms

of the sewers, there need be no connections at all between the cellars and the sewers, as is generally the case in the lower portions of Paris, where some of the cellars are lower than the sewers. But, where the foundations of buildings are in naturally wet soil, it is very important to have the means of draining them thoroughly.

Some, as already mentioned, advocate excluding altogether storm-water from the sewers and making it flow off over the surface, just as it did before there were any sewers. But the convenience and comfort of getting rid of street-flooding during storms is so great, especially in extensive flat or low-lying districts, that no satisfactory substitute can be found for it in the long run, should it be attainable. Where sewers are at first made avowedly and intentionally too small to admit any considerable portion of storm-water, subsequent managers may be strongly tempted to introduce, here and there, an inlet from the street surface, which, during ordinary storms, would work no injury. The multiplication of such inlets would soon lead to flooding. Such managers would see their folly; and the policy of making the sewers so small originally would be questioned and regretted.

SIZES OF SEWERS.

Many, perhaps most, sanitary engineers take the ground that it is not wise to make sewers larger than sufficient to carry off a quantity of water per hour equal to half an inch in depth over the whole surface drained, in addition to the greatest flow of sewage for any hour in the day, and that, rather than to go beyond this limit, it is better to pay damages for the flooding of basements and cellars when excessive rain-falls occur. This question cannot be settled satisfactorily for all places by a single rule as is shown by experience, in some districts of our largest cities. The flooding of basements and cellars in one district of a city, or in one part of a given district, may cause much greater damage than in another, depending upon their value, the use made of them, and the difficulty of freeing them from offensiveness caused by the flooding. For these reasons, whenever storm-water is to be admitted into the sewers, their sizes should be determined,

not by an arbitrary rule supposed to be applicable everywhere, but by a due allowance for all the local circumstances that bear upon the case.

Some engineers object very strongly to making a sewer any larger than the ordinary rule requires, not only on account of the extra expense, but because of diminished efficiency under ordinary conditions; but there is another side to this question. In the first place, the items which usually make up the cost of a sewer, such as excavation, bracing, pumping and bailing, back-filling, supporting or restoring water- and gas-pipes, and repaving, do not increase in expense at all proportionately to the increase in size of the sewer. Some of them are affected very little by it. In the second place, the difference or loss of efficiency in a sewer having an area of cross-section fifty per cent. larger than required by the usual rules (take, for instance, two pipes, one sixteen inches in diameter, and the other twenty), would, for ordinary daily flow, be far less than is often supposed,—in fact, of little or no practical importance in most cases. In the third place, it has been found that sewers that are liable to be gorged during storms, necessarily have gases expelled from them at such times, unfortunately too often into houses with defective drains.

Though not indispensable, there is an advantage in having sewers large enough for a man to crawl through conveniently, when it becomes necessary to search for unlawful waste of water, or discharges into them of forbidden substances. If to these considerations be added that of reducing to the smallest amount the probability of having flooded basements and cellars, it will be seen that the reasons in favor of making sewers of liberal size are not to be overlooked. Extremes on this subject, as well as most others, should be avoided. The battle which raged so fiercely from twenty-five to twenty years ago, between the advocates and opponents of pipe-sewers, has ceased. Subsequent experience has brought all parties much nearer together, yet the peculiarities of different places leave room for the exercise of careful discrimination, in the application of ordinary rules. If doubt should exist, let the chances of error be on the safe side; that is, in favor of liberal sizes.

In addition to the rain-water that should be provided for

in the sizes of the sewers, it is usual, as before stated, to make allowance for the greatest flow of sewage from houses and all other kinds of buildings during any hour of the day. If the sewers are liberally planned, with reference to carrying off storm-water, especially in a climate like that of Massachusetts, it would be unnecessary to increase their sizes on account of ordinary daily sewage, this being so small compared with the other; but, in determining the sizes of intercepting sewers, or of sewers in a city or town where all or very nearly all the storm-water could be made to pass over the surface of the ground and streets to its natural outlets, the probable amount of daily sewage becomes of great importance. What the future of a city will be in this respect no one can tell. The past and present afford no rule for all places or for the same place in a long succession of years. One city will consume not over twenty gallons of water daily on an average for each inhabitant, another will consume and waste more than one hundred. Something very similar to this may be said of different parts of the same city during the same year, or of the city as a whole during a long course of years. The population per square mile, too, varies in density and character greatly at different times and in different localities. Already the average daily consumption of water by each inhabitant in some cities exceeds one hundred gallons for the whole year; but the use and waste of water in very warm or very cold weather, in northern cities, exceed the annual daily average from thirty-three to fifty per cent.

The daily consumption is supposed to take place, mostly, during ten or twelve hours of daylight; but the enormous waste that must take place, when one hundred gallons and upwards are used daily, goes on by night as well as by day, so that an allowance in determining the sizes of the sewers of twenty gallons of sewage per hour for each inhabitant ought to be abundant for large cities, and extravagant for small ones.

Beside the amount of water or liquid to be admitted to the sewers, it is necessary to fix upon their *inclinations* in order to determine their proper sizes. Ordinarily, the inclinations of the sewers conform to the average surface of the ground, especially when this is nearly uniform in slope for consider-

able distances. In such cases, any material departure from parallelism with the surface involves great expense. At the same time, it is exceedingly important to give to the sewers inclination sufficient to make them self-cleansing with the ordinary daily sewage flowing through them.

Some caution with regard to the inclinations of sewers, as elements in the estimates of their sizes, though not needed by trained sanitary engineers, is necessary for those who have had little or no experience in such matters. It is not the inclination of the bottoms of the sewers, but that of the surface of the water, that gives velocity to the current. When a sewer is very long, the difference between the bottom and surface inclinations cannot be of much importance; but, when a sewer is short, the bottom inclination may have no relation whatever to its capacity for discharging water; in fact, its bottom may be inclined the wrong way slightly, yet, if it be large and half-full or more, it may discharge a great deal of water. On the other hand, a sewer may have quite a steep inclination and yet have a reversed current for a time, if it empty at low tide only, or considerably below high water in non-tidal rivers. The proper sizes for such sewers require special study, in order that storm-water during flood tide or freshets may not enter basements or cellars. Cities already built on low sites present, in this respect, the greatest difficulties, which frequently cannot be overcome without separating the sewage from excessive storm-water and pumping.

Questions connected with intercepting sewers for low-lying districts, pumping works, reservoirs and their accessories are so numerous and important that it would be impossible to give any adequate idea of them in an article of this kind; in fact, each case that arises in practice has its own peculiarities, and can only be safely treated by one who has a knowledge of civil and mechanical engineering in general, as well as of ordinary sewerage works in particular.

Having determined for any locality the quantity of water or other liquids to be admitted into the sewers, and the inclinations that can be given them, their necessary sizes can easily be estimated by rules laid down for such purposes in standard works on hydraulics.

FORMS OF SEWERS.

As that channel having the least length of side in contact with water (the quantity of water being the same for every case) will have the greatest delivery, it follows that a circular form is the best to give to sewers that are either entirely filled or only half-filled all the time. As these conditions, especially the former, are rarely found in practice, modifications of the circular form are found expedient. For ordinary sewers over eighteen inches in diameter, not affected materially by tide- or back-water, the egg-shape (the small end down) presents advantages over all other forms, because the usual flow of water in them has more nearly a semi-circular section than in others; besides, they are more convenient for men to go through in case of necessity than circular sewers of equal area.

Sewers that are filled with back-water much of the time are often more effective with broad and slightly curved bottoms and straight sides, because they drain larger quantities near their bottoms. Such a form may be desirable, when there is no back-water, and when the bottom of the sewer can be but little below the surface, and the quantity of water and sewage so great that only a broad and nearly flat bottom would answer the purpose. Such a form is very common at the lower ends of London sewers, where it would be impossible to have any other, without raising the surfaces of the streets, and, consequently, doing great damage to adjoining property. In passing under railroads and canals, such a form, with double or triple lines of sewers, sometimes becomes necessary.

MATERIAL AND THICKNESS OF SEWERS.

Wood, iron, stone, brick, pottery-ware, and cement are used, according to circumstances, in the construction of sewers. Wood is not a suitable material where it is exposed to the air for a long time; but, where it is under water most of, or all, the time, or excluded from the air altogether, it will last a great while, and is very economical in most parts of this country. Wooden sewers, however, are only to be recommended when but small appropriations are available, and when something more solid is hoped for in the future. It is

difficult to give them the best form of interior surface to discharge water, or to be self-cleansing.

Iron is too costly to be used for the principal material in sewers, except where circumstances would render masonry unsuitable, especially where the sewer must be filled and under some pressure, as in the crossing of valleys and under streams by means of inverted siphons. For bottoms or inverts of sewers, cast-iron has been used at Yonkers, N. Y., in a very economical manner, and is said to be very satisfactory, especially for passing over and through bad ground, where single rows of piling and cap-stringers have proved sufficient for the foundations.

Stone enters largely into the construction of sewers where they require broad foundations and thick side-walls; but, without considerable expense for dressing, it is seldom suitable, in a natural condition, for interior surfaces.

The sewers of Paris are to a great extent built of a very hard, rough stone, and made smooth on their interior surfaces by an excellent quality of cement; but such a mode finds little favor in this country or in England, for the reason that excellent bricks are to be had in almost every town at moderate prices as compared with dressed-stone work.

Bricks, when properly made and burnt, cannot be surpassed by any other material of equal or less cost for the construction of sewers of two feet in diameter and upwards. Great care should be exercised in the selection of them, as none but those made of well-pugged clay, having a proper mixture of sand and very hard burnt, are fit for sewers. Arch- or wedge-shaped bricks are very desirable in many cases, but they are not indispensable, when good cement can be obtained. The smoother and more uniform the surfaces of bricks are, the better for the interior surfaces of sewers. Other things being equal, the less water a brick will absorb, and the denser it is, the better.

Vitrified clay, or stoneware, is now very largely and successfully used, not only for pipe-sewers, but for the inverts of brick ones in troublesome soils. At first, serious errors were committed in its use, so that pipe-sewers often failed; but now the requisites of quality and strength are so well understood that failures very rarely, if ever, occur, when proper

skill and care are exercised. A great practical difficulty is that of making them perfectly true in shape; but, by selecting those that vary only slightly and similarly from the exact form, and placing them together in corresponding positions, all objectionable irregularities on the interior surfaces may be avoided.

Stoneware invert is useful for the bottoms of sewers, because they present smooth surfaces to the ordinary flow of sewage, and because the openings in them afford channels for running water, the presence of which would otherwise prevent proper hardening of the cement and make it very difficult to obtain smooth and tight joints.

Cement, beside being used so universally in the construction of brick and stone sewers, is very largely used with sand or sand and gravel, in the manufacture of pipes. In most parts of this country, they can be afforded at a less price than burnt-clay pipes, and, when made skilfully and honestly, have given satisfaction; but the difficulty of obtaining honest workmanship in cement pipes is much greater than it is in the case of vitrified clay. In Milwaukee, broken slag is said to have proved very valuable in the manufacture of pipe-sewers.

Acids which do not attack the burnt clay sometimes ruin cement sewers. If those must be used, let them be made of Portland cement, the manufacture of which has already been satisfactorily established in this country at a price much lower than that of the imported article.

The proper thickness of sewers depends not only upon their sizes and forms, but upon their depths below the surface, and upon the kinds of soil in which they may be built. It is necessary, also, to give sewers, whose tops are near the surface of the streets or roads, extra thickness, or some other protection, lest they be crushed in by the passage of heavy loads over them. Except where it is unavoidable, sewers should never be placed within the reach of frost.

Usually, the work of excavating for sewers, putting them in place, and restoring the surface to as good condition as before, is very simple; but, where deep cuts are required in bad ground, and there are large water- or gas-pipes, and perhaps old sewers and house-drains that must be maintained in use all the time that the work is going on, great care and

skill are required. If, at the same time, the streets should be narrow, and if important buildings be situated on them, the danger of doing serious damage will be great. For such work, it would be exceedingly unwise, if not criminal, to employ any but skilled persons with actual experience in similar operations. Bracing and sheeting in two or more tiers may be required, and very few contractors or workmen understand such work.

In order to prevent the settling and perhaps ruin of buildings, and sometimes to render the completion of the work itself practicable, it is necessary, when the soil consists largely of wet, running sand, to sink small wells or shafts below the level of the sewer, and then lower the level of the soil-water by pumping, in such a gradual manner as not to bring up much sand with the water. This takes time,—it may be only a few weeks, it may be several months. Without this precaution, the proper construction of the sewer may be very difficult, if not impracticable. An error or oversight in operations of this kind may cause the sides of the excavation to cave or run in, to the serious damage of property, and perhaps with loss of life.

DEPTH OF SEWERS.

No rule, adapted to all cases, can be laid down for fixing the depth of sewers. Where the object in view includes not only the removal of kitchen and other waste liquids from houses, but of soil-water from below their foundations, it is very evident that the bottoms of the sewers must be lower than the bottoms of the foundation. They should also be low enough to permit branches to enter them at such an elevation above their bottoms as not to be subject to back-water and deposits in consequence. If practicable, the house-drain junctions should be nearly or quite as high as the centres of the sewers; but this is not an absolute necessity when important reasons make a departure from the rule desirable. It would be better to lower the junction to within six or eight inches of the bottom of the sewer, than to lose an opportunity of thoroughly draining the foundations of a house.

In parts of some cities, the requirements of business and of subsoil drainage render it necessary to place the house-drains

fifteen feet or more below the surface of the street ; in other parts of the same cities, a depth of six or seven feet would be quite sufficient. Where practicable, the bottoms of the sewers should be not less than thirteen feet below the pavements, because the future may and probably will require deeper drainage than the present.

DOUBLE SYSTEM OF SEWERS.

Nearly thirty years ago a double system of sewers was proposed in England, the object being to keep ordinary sewage separate from storm-water. Of course, for ordinary sewage alone, much smaller sewers would be required than those necessary for storm-water ; and, in cases where it might be necessary to pump their contents, a considerable annual saving could thus be effected, while the value of the sewage for fertilizing purposes would be much better preserved. Such a system has very seldom been carried out in Europe, and not at all in this country ; the objection being not only to the expense, but to the complication. If, in the future advance of sanitary science, it should become evident that a double system is demanded generally, or for any city in particular, the previous existence of an ordinary system need not prevent the introduction of the other, although it would then be more difficult and expensive to arrange some of the details, than if both were planned in connection.

ACCESS TO SEWERS.

However skilfully and carefully sewers may be planned and constructed, they are liable, from various causes, to get out of order or repair ; provision should therefore be made for entering and examining them. It is quite common in England and on the continent of Europe to have entrances from the sidewalks, in order to avoid interfering with heavy traffic on narrow streets, but most of their entrances are like those adopted in this country ; that is, man-holes placed immediately over the tops of the sewers and opening into the streets. They are provided with covers at the surface of the streets, and often with permanent ladders inside,—a necessary arrangement, when the man-holes are unusually deep. When sewers are large enough for men to walk through them, man-

holes are not needed so frequently, and only at ordinary street crossings; but, on the lines of pipe and small brick sewers, they should not be more than from one hundred and twenty-five to one hundred and fifty feet apart. In England, lamp-holes are sometimes placed along the lines of small sewers, at changes of direction between the man-holes. They are made just large enough to admit a lantern, which may be seen from the nearest man-hole on either side. In this country, however, lamp-holes do not appear to be used, but man-holes, though more expensive, take their place. Within a few years, contrivances for introducing lights with reflectors into sewers and shoving them through from man-hole to man-hole on jointed rods render it practicable not only to examine the interior of sewers, but to get the exact position of any object discovered. Such contrivances are especially valuable for detecting the wrong use made of house-drains or the unlawful waste of water.

BRANCHES AND JUNCTIONS.

Branch sewers should always be curved toward the mains, and enter them at angles of not more than forty degrees with the direction of the current in the main sewer. The same rule holds good with regard to junctions of house-drains with main and branch sewers. Sewers originally having house-drains entering at right angles—and thus rendered so inefficient during heavy rain-storms as to cause flooding of basements and cellars—have been found abundant in capacity after replacing the square junctions with curved ones entering at proper angles.

HOUSE-DRAINAGE.

It is unnecessary to add to the very full and able article on this subject by Mr. E. S. Philbrick, published in the last annual report of the Board, although the subject is inseparably connected with that of sewerage. Mr. Philbrick very judiciously states that arrangements which work well in England may not be adapted to the northern portion of this country, with a climate so different; and yet some are apt to think that whatever is recommended after long experience in England ought to be proper here.

Much is said by some engineers against laying drains under buildings, and, if it can be avoided, it certainly should be done ; but this is not always practicable, unless the streets and alleys, as well as building lots of a city, have been laid out in a suitable way. Even then it is impossible to supply buildings of much depth with modern conveniences without drains of some kind either under or through the basements, the latter being much the more objectionable. In no case, however, should one common drain be allowed to pass under several adjoining buildings, even if owned by the same persons. In such cases, the carelessness of one occupant may greatly annoy all the rest. This may happen where a drain is laid through several private lots in the rear of buildings.

SUPPLY OF WATER.

Sewers well adapted for the removal of fecal matter and other refuse would only be a curse, if they had not a sufficient supply of water to carry those matters without stoppage to the outfalls, or, at least, to cover by a constant current deposits that might take place, and which must be removed from time to time, by flushing, by machinery, or by hand. It is understood, of course, that in a perfect system of sewers, deposits will not take place, but in practice, owing to peculiar local circumstance, perfection is not always attainable. Even sewers constructed simply for the removal of storm-water from the surfaces of streets, houses, and lots, and from which all house and manufacturing refuse is strictly excluded by law, have become exceedingly offensive in seasons of protracted drought, owing to putrescible substances that enter them from street surfaces,—a difficulty which no care can wholly prevent.

An abundant water-supply is not only essential to the proper working of the sewers, but sewers become necessary when there is an abundant water-supply. In fact, the two are just as indispensable in a perfect sanitary system as veins and arteries are in the human body.

FLUSHING.

Some writers on sewerage contend that sewers should be so planned as to be kept always free from deposit by the ordi-

nary flow of sewage through them, and, if unexpected deposits should be formed, they will be removed by occasional heavy storms. The standard held up by such writers is the correct one wherever it is practicable to conform to it, but there are situations where this is not the case and yet where sewers of some kind are indispensable. It should be remembered in this connection that there is a very wide difference between sewers that have but slight deposits in them, inoffensive because covered with a constant current of water, and those which may be justly termed "elongated cesspools" reeking with deadly vapors.

There can be no doubt that a sufficient current of water through sewers will render innocuous slight deposits on their bottoms. On the other hand, a sewer with all the inclination required by the safest rules, without this supply, will become offensive. We cannot be certain that everybody or every neighborhood will use or waste the quantity of water requisite to make sewers "self-cleansing," as it is termed, in contradistinction from occasional or periodical flushing or cleansing by other artificial means. Heavy rain-storms may occur at such irregular and long intervals as not to prevent offensive deposits in some sewers with good inclinations.

In order to produce the greatest effect in flushing sewers with a moderate amount of water, it should be done suddenly with as great force as is possible without the risk of flooding basements or cellars. Various expedients have been devised for this purpose, among the most efficient of which are fixed reservoirs at the upper ends of sewers, and portable tanks holding fifty barrels or more. The latter can be filled from fire hydrants and poured into man-holes, which must be provided with temporary dams (simple boards or buckets often answering the purpose), to prevent the water from escaping in the wrong direction. This method is very efficient for removing light or soft deposits from sewers of two feet or less in diameter, but, for larger ones, it will be necessary to provide larger supplies of water, by letting it in either from streams or from basins, where this can be done, or to insert flushing-gates at different intervals according to the inclinations of the sewers, by means of which the sewage itself can be dammed up for a while and then suddenly let

loose. When hard deposits are suffered to form on the bottoms of the sewers, it is generally necessary to remove them either by hand or machinery.

VENTILATION OF SEWERS.

The importance of removing bad air from the sewers cannot be overestimated, but the methods proposed for effecting it are various, owing partly to differences of circumstances and partly to discordant views. The unpleasantness as well as unhealthfulness of sewer-gases generally has often led to attempts to prevent their escape at either end of the sewer, or between, nobody wishing to have them on or near his premises. The consequence has been their escape into houses and at other objectionable points, for they will escape somewhere, no practicable device yet having been made to prevent it and at the same time to permit the sewers and drains to be used.

This question leads to the discussion not only of expedients for the removal of gases from sewers, but also of the best methods of rendering those gases innocuous. While it is possible to purify bad air to a limited extent, by means of absorbents or substances that will form new and harmless combinations, it is evident that the great purifier, upon which all must depend, is the atmosphere itself, just as the sea is the great purifier of the waters that flow into it,—with this important difference, however, that, while the sea or any large body of water is inaccessible for sanitary purposes to many populous districts, the atmosphere is everywhere pressing upon us, on all sides.

The English have done more than all others to work out the problem of sewer-ventilation. Without attempting to describe the numerous devices, patented and unpatented, for this purpose, it may be said safely that the result of past experience proves that the more freely air is allowed to escape from the sewers from all points, except the interior of houses and other buildings occupied by men, the better it will be for the public health. If not only from every tall chimney, but from every house-top, aided by the heat of kitchen fires, there were escapes for sewer-gases, and at the same time there were frequent openings from the sewers into the streets for the free entrance and exit of air, there would

be little or no complaint of the nuisances now so common. In such a state of things, there would be, frequently, if not most of the time, currents of air from the streets into the sewers, and consequently far less offensive gases escaping from the tops of houses and other places. If a large amount of ordure could be scattered in minute quantities over an extensive field, though it might be perceptible for a short time to the senses, it would soon become inoffensive ; but, if it should be piled up in one spot near a building, it would not only remain offensive for a long time, but would become positively dangerous. Such cases are too well known already.

In our northern climate, it would be difficult, though not impracticable, to keep street openings, which must be protected by gratings or perforated covers, free from obstructions, such as ice or frozen earth ; but the object in view would justify the necessary trouble.

CONTRACTS, SPECIFICATIONS, AND INSPECTION.

Considering the common danger there is of the misuse of public funds and of the difficulty in preventing it, the contract system of executing public works will, no doubt, continue to be generally adopted. In some cases, public interest requires a departure from it, but, on the whole, it will be found the most economical. Exceptions to this rule are work which, if not well done, might prove highly injurious to the usefulness of the sewers, and work of such a doubtful character, as regards difficulties to be overcome, that no responsible contractor would be willing to take it without charging excessively for the risk.

The contract system requires constant and immediate supervision by inspectors, under the direction of the engineer and his assistants. Great care must be taken to select inspectors not only competent but honest ; otherwise, they will be worse than useless. Contractors sometimes pay inspectors more than their legitimate employers do, and, of course, expect to make money by the operation, to the injury of the work. When inspectors are appointed to reward them for political services, they are very apt to prove either inefficient or dishonest, though honorable exceptions are met with.

In order to reduce the dangers of the contract system as

much as possible, the custom of purchasing brick from one party, cement from another, pipes from another, etc., thus removing from the contractor for building the sewers all temptation to use improper materials, has been adopted in Providence with very satisfactory results. To a more limited extent this system has been adopted in other cities.

In the drawing up of contracts, great pains should be taken to provide for every possible contingency, as well as all positively known requirements, and, if possible, in language not to be misunderstood. This course is the only one to prevent lawsuits or long and sometimes vexatious proceedings in connection with final settlements. It will always be prudent to examine forms of contract and specifications found to answer well after long experience in other cities, and to select from them such portions as may be applicable to the case in hand.

Engineers are often exceedingly hurried in the preparation of plans and specifications, because the commissioners or other authorities insist upon a very early commencement of the work, supposing that an engineer is, or ought to be, capable of drawing up contracts and specifications with the greatest rapidity. The actual time required depends upon the character of the work, ranging from a few days in some cases to many months in others.

MAINTENANCE OF SEWERS.

Sewers require looking after when in actual use. The immediate care of them should be given to some one trained to such work, or at least familiar with those he has charge of. He should be assisted by men also familiar with the work. Usually, a peculiar fitness for such services on the part of some men is developed during the construction of the sewers. When such men have been tried and found faithful, they should be retained permanently,—at least not changed every time the political complexion of the city government may change. It is much to be regretted that the English system with regard to such matters could not be introduced into this country. There, such officials are retained for life or during good behavior; and, if incapacitated for duty by old age or other infirmity, after long and faithful service, they are retired

upon pensions. They are not allowed to be partisans in politics, or even to vote; a very different state of things from that which exists in some of the cities in this country, where such officials are required to vote for and contribute money to help elect men they may despise, under threats of losing their positions if they do otherwise.

RECORDS.

It is of the greatest importance to have records of everything done in connection with the sewers. Plans and sections of all parts of the work should be carefully arranged in convenient volumes or drawers, and on them should be found not only the position and size of every main and branch sewer, but of every catch-basin or other inlet, man-hole, drain junction, and tide- and flushing-gates, if any. It may prove of great service to be able to refer at any time to the exact date of the completion of any part of the work, the parties who did it, and the cost. Such information is usually quite accessible at first, but not always so when a few years have passed away. Inspectors' reports, which are usually made out on printed forms, and journals containing accounts of daily proceedings and occurrences in connection with the work may not only prove of much interest, but be of great importance in case of lawsuits, and in determining the durability of some kinds of material.

DISADVANTAGES CONSIDERED.

There can be no doubt but that some evils have occurred in connection with sewers, so that cities or parts of cities can be pointed out which were freer from certain diseases, especially typhoid fever, before having sewerage works than after. This is not the common result; the opposite can be confidently affirmed. Modern medical science has made great progress in discovering the causes of the origin and spread of disease, and seems to be on the point of making still greater advances. The engineer, on becoming acquainted with the results thus obtained, is deeply impressed with the limited though essential part sewers have to do with the health of cities.

Sanitary science is too vast in all its bearings to be limited

to brick and mortar or ponderable substances of any kind, and can only be built up and successfully applied by the coöperation of all the professions that study its different branches.

If an occasional outbreak of disease can be traced to sewers, some defect or neglect will generally be discovered in connection with them; but, if not so always, it still remains that sewers, like all other channels which convey good, are capable of transmitting evil,—like the nerves of the human system, which are of greater benefit than can be imagined in health, and even in sickness, but may be sources of intense agony in case of injury or disease.

THE SANITARY CONDITION OF LYNN.

BY J. G. PINKHAM, M. D.,

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I.—NATURAL CONDITIONS AFFECTING HEALTH.

II.—THE POPULATION.

III.—ARTIFICIAL CONDITIONS AFFECTING HEALTH.

IV.—RATES OF MORTALITY.

V.—PREVAILING DISEASES.

VI.—HEALTH OF DIFFERENT DISTRICTS AND STREETS.

VII.—CONCLUDING REMARKS.

THE SANITARY CONDITION OF LYNN.

On page 204, line 13 of the table, for 1.2 read 2.2.

On page 216, line 13, for 1866 read 1865.

Topography.—The surface of the land is varied, but may be described in general terms as a plain bordering the sea, with an irregular chain or mass of hills in the rear. Beginning in the extensive salt marshes on the west, this plain rises gradually toward the east, reaching its highest elevation in the region known as Sagamore Hill, and its next highest at the junction of Broad and Atlantic streets. Beyond these points it falls off again, at first gradually, afterwards more abruptly, to the ocean and the valley of Stacey's Brook. The plain rises, also, as it approaches the line of hills. In the westerly section of the town this rise is very gradual; in the central portion, it is decided; further east, it becomes again less marked. The slopes are nowhere uniform, but are broken by moderate elevations and depressions from the general line of ascent or descent. In the easterly portion of Lynn is a great valley, geologically speaking, of which the valley of Stacey's Brook forms a part. It extends through a wide gap in the range of hills, and far inland; being occupied, within the limits of the city, by a chain of lakes with their connections, and the two outlying villages of Glenmere and Wyoma.

To the southward of Lynn is Nahant, a "peninsular island" connected with the mainland by a long, narrow isthmus, on

* Under this head are given only those facts which are thought to have at least a general bearing upon the healthfulness of the region. Some portions, which are merely descriptive, are necessary for a complete understanding of what follows.

one side of which are Long Beach and Nahant Bay, and on the other Lynn Harbor, a shallow body of water extending westward to the marshes and Revere Beach. The bottom of the harbor is nearly bare at low water, only the few channels by which it is rendered navigable remaining covered.

The hills in the rear of the city are rough, lightly wooded where they have not been cleared, and of moderate elevation. They are only to a limited extent inhabited. The most southerly of them is High Rock, a naked bluff, 188 feet in height, almost perpendicular on its seaward or southern side, but sloping away gradually on the north. Further inland is Pine Hill, the highest of the series, being 230 feet above the level of the sea. The distributing reservoir of the city water works is on this hill.

Fresh Waters.—The "Lakes of Lynn" are situated in the north-easterly section of the city. Of these, the largest is Flax Pond, or Wenuchus Lake, a beautiful sheet of water some seventy-five acres in extent. Its outlet is Strawberry Brook, which flows southward through a gap in the hills, and empties into Saugus River. Connected with this pond, a short distance further inland, is Sluice Pond, which has steep, gravelly banks, and is very deep. Still further inland is Cedar, or Spruce, Pond. Spring Pond, to the north-east of the last, is partly in Lynn and partly in Salem. Floating-Bridge Pond lies to the east of Flax Pond, in the same great valley. Its outlet is Stacey's Brook, which also receives the overflow of Bog Meadow, through which it flows, emptying finally into the ocean near the line of the town of Swampscott. Silver Lake, situated in a hollow in the rear of the large school-house on Essex Street, is very small, and has no outlet, but is noticeable for its exceeding foulness. Goldfish Pond occupies another undrained hollow in the course of Fayette Street. Saugus River forms the western boundary of Lynn for a short distance. It is here, however, rather a salt-water estuary, or creek, into which the river empties, than the river itself. Its course through the marshes is winding and sluggish. Stony Brook flows from the hills in the west, and joins with Strawberry Brook at the foot of Tower Hill. Beaver Brook receives quite a large branch from the north,

called Birch Brook, and empties into Saugus River at the old stone factory.

The waters of all these ponds and brooks are naturally clear and sparkling. Chemical analysis, moreover, has shown that, when uncontaminated by sewage, they are pure, and of excellent quality for domestic use, containing no hurtful mineral constituents, and but a moderate amount of organic matter.

Accompanying this Report is a map, which, in connection with other things, shows all the topographical features of the country, as they have been described. It explains itself sufficiently. What is to be said hereafter in regard to the natural drainage of the region, will be rendered intelligible by a reference to this map. The elevations of the land above the level of the sea (low water) are indicated in Arabic figures. The difference between the high and low water marks is reckoned at ten feet.

Soil.—This term is here used as synonymous with loam or surface-soil. The soil of the highlands is thin and gravelly, non-retentive of moisture, and naturally sterile. It may be considered a warm, dry soil. The marshes and bogs are covered to a great depth with muck or peat, wet at all seasons of the year. This is a cold soil, having but little power, relatively, of retaining the heat received from the sun's rays. On the arable lands which border the marshes at West Lynn, is a deep and very productive vegetable loam. It retains moisture well, and is somewhat warmer than the soil of the undrained marsh. Elsewhere in the city the soil is intermediate in character between the gravelly loam of the highlands and that last described. In most places it contains a considerable amount of vegetable matter, and is sufficiently retentive of moisture to be productive. The amount of moisture actually present in it depends much upon the subsoil, and is very variable in different sections.

Subsoil.—The subsoil of the highlands, where any exists, is coarse gravel. On all the level portions of the city, clay has been found with such uniformity, wherever excavations have been made, as to suggest the probability of a continuous stratum. The depth of the clay beneath the surface varies greatly. In some places it comes up nearly or quite to the

loam, as on Holyoke and Harbor streets. In other places the stratum dips down, forming basins and valleys of varying shape and extent. Between the clay and the loam are ranged strata of fine and coarse gravel and sand, mixed with boulders. The gravel and sand are very loose, and readily permeable by water. We can easily account for the undulating and irregular character of the clay stratum, by supposing it to have been deposited as a sediment in comparatively quiet waters, taking the shape of the bottom, its surface being afterwards acted upon, worn away here and piled up there, by the same agencies that covered it so variously with the products of the drift period. The depth of the clay beneath the surface, so far as it has been ascertained, is indicated on the map in Roman numerals.

Rocks.—The foundation rock of the greater portion of Lynn is porphyritic felsite. It crops out and manifests its character in many places; notably at Red Rock on the coast, at High Rock, and all along the seaboard line of hills. It is very compact, but presents, nevertheless, many seams and fissures for the percolation of water. Mr. J. M. Rowell of this city, who has carefully studied the geology of the region, says that, so far as the rock has been penetrated, it shows evidence of the recent action of water, in the occurrence of dendritic oxide of manganese, which he considers due to that cause. Prof. T. Sterry Hunt says, "The porphyry of Lynn is a stratified crystalline rock, belonging to the Huronian series." This places it well down among the rocks now styled Eozoic or Archæan.

The northern part of Lynn is in the region of hornblendic granite.

Natural Drainage.—As the amount of moisture in the earth of any locality is largely influenced by its natural drainage, this subject becomes an important one in its bearing upon healthfulness, and demands careful consideration. Natural surface-drainage depends mainly on the slope of the land; natural underdrainage on the nature and disposition of the subsoil. Bearing this fact in mind, in connection with what has already been said, we shall readily see that the extensive, low-lying portion of Lynn, which has been called the "plain,"

with its moderate and varying slopes and irregular substratum of clay, is likely to present some sections that are imperfectly drained by nature. This is found, on examination, to be the case. The rise from the water and the flats to the hills is, in many places, so gradual, that a slight interruption in the ascent creates a break in the surface-drainage, which causes the soil to be wet much of the time; and when coincident with a basin-shaped disposition of the impermeable substratum, leads to the formation either of an open pond or of a bog in which the line of soil-saturation comes nearly, or quite, to the surface. "Bog Meadow" is a conspicuous illustration of the latter. So, also, are the bogs which once existed on each side of Franklin Street. They are now drained, and the land is mostly occupied by dwellings. The overflow of the bogs formerly made two brooks; one of which flowed into the "Frog Pond," on the Common, thence southward to the marsh; and the other along the course of Johnson Street to Munroe, where it joined a similar brook coming from the hills in the direction of Union and Ireson streets. The two together entered the mill-pond.

In the west are long stretches of wet lands along the lower course of the Strawberry and Stony brooks; and on Holyoke Street, where the open fields are extensively occupied by brick-yards. Similar lands exist also in the east, about portions of Stacey's Brook and its two branches from the northeast. On all these wet lands the level of the subsoil water is, in rainy seasons, near the surface, and never very far below. This keeps the surface-soil nearly always damp. Other portions of the plain are naturally well drained. This is true of what will be described further on as the "Ocean District." It is also true of the greater portion of the "Common District," which, although quite low-lying and nearly level, yet is protected from dampness by a deep, open subsoil, and good natural underdrainage. Wherever the clay comes to or near the surface, as on Mulberry, Pleasant, Harbor and Beach streets, there the soil is usually wet; more particularly where the land is situated at the foot of the hills.

Wyoma Village forms part of the watershed of Flax and Sluice ponds, and is naturally well drained. The same is

true of Glenmere, except that portion which hugs Bog Meadow and the marsh about Floating-Bridge Pond.

Along the foot of the hills, in some places, are springs ; and cellars dug into the rock are often wet from this cause.

Of the natural drainage of the highlands and salt-marshes, which present the two extremes of completeness and incompleteness, it is not necessary to speak in detail.

Climate.—Exposed as it is on the south and east to the winds of the sea, and partially protected from land breezes by a range of hills, Lynn must be considered as having an essentially maritime climate. Yet there are two circumstances which conspire to modify the influence of the sea, and to give us here, at times, a drier air, and subject us to more marked and sudden changes of temperature than would at first thought seem probable.

In the first place, the bodies of salt water upon which Lynn is situated, are partially land-locked (see "Topography"), so that only those winds which blow directly from the east come from the great ocean without passing over any portion of the land ; and these are not felt equally in all parts of the town.

In the second place, the prevailing winds are westerly, and have the dry character which usually belongs to continental breezes. They are also colder in winter and warmer in summer than the sea breezes. By the expression "prevailing winds," is meant that they blow more than half the time.

Besides, the rainfall of Lynn is, from local causes, less than that of the neighboring regions north and south of it. But it must be remembered that the climate is largely determined by those conditions which pertain to the continent and latitude, local influences only sufficing to modify it. Some of these points will be more fully set forth as we proceed.

No complete record of meteorological changes has ever been made in Lynn, so far as I have been able to ascertain. Mr. J. C. Houghton has, however, for many years, noted the temperature, the direction of the winds, and the general character of the weather ; and he has kindly prepared for me a summary of his observations for the past seven years, from which I have derived the general conclusions given below.

His observations were made morning, noon, and night, and an average taken for the day.

Temperature.—Under this head I shall speak of the annual, seasonal, monthly, and diurnal variations.

Annual Variations.—The average temperature of the year is 47.5° F. The difference between the warmest and coldest years of the series is 4.7° F. Ordinarily the variation from year to year is much less than this.

Seasonal Variations.—The average temperature of spring is 42.8° F.; of summer, 69.1° ; of autumn, 49.6° ; of winter, 27.3° . The mean difference between summer and winter temperature is 41.8° ; between winter and spring, 15.5° ; between spring and summer, 26.3° ; between summer and autumn, 19.5° ; between autumn and winter, 22.3° .

Monthly Variations.—Below is given the mean temperature of each month of the year:—

February (coldest),	26.13° F.	October,	51.04° F.
January,	26.92°	May,	55.56°
December,	28.19°	September,	60.93°
March,	32.54°	June,	66.33°
November,	38.28°	August,	69.30°
April,	42.85°	July (warmest),	71.41°

The difference between the warmest and coldest months is, on the average, 45.28° F. Occasionally, January is colder than February; and December has been known to exceed them both in this particular. In the same way August disputes with July its right to the title of the warmest month.

Diurnal Variations.—The highest average temperature noted for one day during the whole period, was 86.6° F., and the lowest 0. It is comparatively rare for the temperature to remain for many hours below zero, or above 90° ; but it is not unusual to note a rise or fall of twenty, thirty, or even more degrees in the six hours intervening between the morning and noon and the noon and evening observations. The average of these diurnal variations has not been determined; but it cannot be very high, for many of the days are nearly uniform in temperature throughout, only a moderate rise taking place near noon.

Prevailing Winds.—From the observations of Mr. Houghton, we may safely deduce the generalization, that our prevailing winds are westerly. But it must be remembered, that we are in the region of variable winds; that they are liable to change several times a day; and that the most we can hope to attain in any statement of this kind is an approximation to the truth. Westerly winds are almost exclusively prevalent in November, December and January; easterly ones more so in April, May and June. The westerly winds are remarkable for their dry character. The rapidity with which moisture disappears from the earth in this region, after a rain-storm has been succeeded by a north-west wind, is often noted. Easterly winds are laden with moisture. Sometimes, but rarely, they bring in fogs which envelope the land. Along the coast the diurnal changes are perceptible whenever the local currents of air are not overborne by some stronger general ones. They are little felt in West Lynn, but more decidedly so in the east, where the coast-line trends towards the north, exposing the shore to the breezes of the great sea.

The Weather.—From the observations made, it appears that, on an average, about 54 per cent. of the winter days are fair; 28 per cent. cloudy; 8 per cent. rainy; and 10 per cent. snowy. In the spring, 65 per cent. of the days are fair; 19 per cent. cloudy; 11 per cent. rainy; and 5 per cent. snowy. In the summer, 76 per cent. of the days are fair; 13 per cent. cloudy; and 11 per cent. rainy. In the autumn, 69 per cent. of the days are fair; 18 per cent. cloudy; 12 per cent. rainy; and 1 per cent. snowy.

Taking the year together, 66 per cent. of the days are fair; 19.5 per cent. are cloudy; 10.5 per cent. are rainy; and 4 per cent. snowy. The terms "fair," "cloudy," etc., are used in a popular sense, and denote the predominant character of the day. We can hardly claim, in this region, that we do not have a good proportion of pleasant weather, nor that the distribution of it is excessively unequal throughout the year. The figures above given will probably surprise some who are wont to consider our climate excessively harsh and disagreeable.

Rainfall.—The fact that our average annual rainfall is less

by some inches than that of Boston and the cities north of us, has only recently been discovered. The difference, so far as determined, is shown below :—

Y E A R .	Lynn.	Boston.	Salem.	Lowell.
1873,	39.458 in.	54.94 in.	40.88 in.	45.05 in.
1874,	34.917 in.	41.09 in.	34.89 in.*	41.75 in.
1875,	41.847 in.	51.01 in.	51.62 in.	43.63 in.
Average, . .	38.74 in.	49.01 in.	43.68 in.	43.47 in.

The average of Eastern Massachusetts is 42 inches. The explanation of this low rainfall is, perhaps, not easy to give. It has been suggested, that it may be due to the range of hills, but they are too low. Another, and more plausible explanation, is, that summer showers rarely visit us in their fulness. As they advance from the west, they seem to follow the course of the Ipswich and Merrimack rivers on the north, or the Charles and Mystic toward the south, leaving Lynn in the triangle, to receive at most only the edge of a wetting. But whatever the cause of the phenomenon, it cannot be without some effect upon the moisture of air and soil.

Relative Humidity of the Air.—A sufficient number of observations in regard to this point have not yet been taken to warrant any sweeping conclusions. The most striking characteristic thus far noticed, is a tendency to decided changes from moist to dry, and from dry to moist.

In concluding this division of our subject, it may be affirmed that the natural conditions in the midst of which Lynn is placed, are, in the main, favorable to health. The winter cold is not only endurable, but positively invigorating. The summer heat, tempered as it is by the breezes of the sea, is not sufficiently great or prolonged to cause disease, except in coincidence with artificial conditions which affect the human system unfavorably. The dampness of the soil, observed in many sections, is a defect for the most part easily remedied by art. The water of the locality is naturally pure, and the air clear.

* Eleven months.

II.—THE POPULATION.

The population of Lynn, as given by the different state and national census reports since 1849, is shown below :—

1850,	.	.	.	.	14,257	|	1865,	.	.	.	.	20,747
1855,	.	.	.	.	15,713	|	1870,	.	.	.	.	28,283
1860,	.	.	.	.	19,083	|	1875,	.	.	.	.	32,600

Rate of Increase.—From these figures we estimate the average annual percentage of increase for the several quinquennial periods, as follows :—

1850 to 1855,	.	.	.	.	1.95	|	1865 to 1870,	.	.	.	.	6.36
1855 to 1860,	.	.	.	.	3.96	|	1870 to 1875,	.	.	.	.	2.93
1860 to 1865,	.	.	.	.	1.69	|						

The general average for the quarter century is 3.35. From these percentages we may calculate the population for any intermediate year with a reasonable degree of exactitude.*

The low rate of increase from 1860 to 1865 has an obvious cause in the war, which drained the city of its vigorous men, and for a time paralyzed its industries. From 1865 to 1870 the growth was remarkable. It probably began the year before the census was taken, and continued somewhat beyond the census of 1870; but from the nature of the case these facts cannot be shown by figures. The cause of the sudden rise in the rate of increase is to be found in the returning prosperity of the country at the close of the war, and the great stimulus given to the peculiar industries of Lynn, by the general introduction of machinery, after the invention of the McKay sewing-machine. The population of Lynn varies somewhat with the rise and fall of the business tide. It is estimated that during a busy season, when the shops are in full operation, there are many hundreds, possibly some thousands, more people in the city than during a dull season of the same year. These people, attracted to the city by the prospect of good wages and plenty of work, fill to overflowing the boarding-houses, and for a time give a crowded appearance to the streets; but when work slackens they go back to their country homes, or seek employment in some other place until the ebb-tide is past in Lynn.

* To estimate the rate of increase, we have employed the usual formula, deduced from the well-known principles of geometrical progression.

Sources of Increase.—The rapid increase in the population of Lynn has been largely due to immigration. The birth-rate is low. From 1860 to 1875, the average is but 26.7 per thousand of the population. The average death-rate for the same period is 19.5, giving us a difference of 7.2 per thousand, or .72 of one per cent. Even if we make a liberal allowance for defects in the registration of births, we shall be forced to look to immigration as the main source of supply. The domestic sources from which Lynn receives its immigration, are chiefly Maine, New Hampshire and Vermont. The towns of Massachusetts largely contribute. The foreign sources, named in order of the number of immigrants, are Ireland, the Dominion of Canada, and England. A few come from other parts, as Scotland, Germany, France, etc., but the numbers are so small as to render them of no account in any computations respecting health.

Nationality.—Of the 32,600 people existing in Lynn in 1875, according to the late census, 5,691 were reckoned of foreign birth. This is a percentage to the whole population, of 17.4. Of these, 3,344, or 58.7 per cent. of the foreign born, and 10.2 per cent. of the population, are from Ireland, 1,685, or 29.6 per cent. of the foreign born, and 5.1 per cent. of the population, are from the Dominion of Canada, 425, or 1.3 per cent. of the population, and 7.4 per cent. of the foreign born, are from England. The remaining 4.3 per cent. of the foreign born are from other places.

But this statement does not give a fair idea of the race of the foreign born, inasmuch as many of those from the Dominion of Canada are of Irish, English and Scotch parentage; while many from Canada proper are of French descent, and are so distinct in their characteristics as to form a race by themselves. The Irish undoubtedly bear a rather larger proportion to the whole population than these figures show.

The census reports do not give the number of children of foreign parents; but by direction of the State Board of Health, Mr. J. Carruthers of this city made a special enumeration from the schedules of the last census, covering this point, and that of the population by streets. The Board are indebted to the chief of the Census Bureau, Carroll D. Wright, Esq., for his kindness in forwarding this work. By

this enumeration it was ascertained that the foreigners and their children in Lynn, in 1875, numbered 9,309; a percentage to the whole population of 28.5, leaving 23,291, or 71.5 per cent., to be classed as of native and mixed parentage. The former will be called foreigners hereafter, for the sake of convenience, and the latter natives. The two classes will be kept distinct, to a certain extent, in computations.

If we suppose that the same ratio between the foreigners and their children obtained in 1870 as in 1875 (and this cannot be far out of the way), the number then existing would be 8,071. This gives an increase of 1,228; an average annual per cent. of 2.90, a little less than that of the city at large. The birth-rate among the foreigners is higher than that among the natives; but the death-rate is much higher still, so that it is safe to affirm, with respect to Lynn, at least, that the foreigners are not increasing as fast as the natives.

Age-Distribution.—The age-distribution of the population of Lynn is given below, in several different groupings:—

A G E .	Number.	Per cent. of Population (to tenths).	A G E .	Number.	Per cent. of Population (to tenths).
Under 5, . . .	3,280	10.0	90 to 100, . .	11	0.03
5 to 10, . . .	3,185	9.7	Unknown, . . .	83	0.2
10 to 15, . . .	2,746	8.4			
15 to 20, . . .	3,243	9.9	Under 15, . . .	9,211	28.3
20 to 30, . . .	6,669	20.4	15 to 60, . . .	21,309	65.3
30 to 40, . . .	5,547	16.9	Over 60, . . .	1,997	6.2
40 to 50, . . .	3,696	11.3			
50 to 60, . . .	2,154	6.6	Under 20, . . .	12,454	38.2
60 to 70, . . .	1,301	3.9	20 to 50, . . .	15,912	48.8
70 to 80, . . .	536	1.6	Over 50, . . .	4,151	12.8
80 to 90, . . .	149	0.4			

What strikes us in this statement is the small number of children under five years of age. It is less than that of Boston, and of the State at large, by .5 per cent. Another point to be observed is the large number of vigorous adults. As compared with the whole State, the number between twenty and fifty is 4.2 per cent. larger. It does not differ much from Boston in this respect. Lynn also contains a less percentage of people over sixty than the State. Thus we see

that it has a large relative number of those who are in the vigorous, productive ages, and a small relative number of those who are in the feeble, dependent ages. For this reason it ought to have a somewhat lower death-rate than places in which the opposite conditions obtain.

The Sexes.—Forty-seven per cent. of the population of Lynn are males; 53 per cent. females. This percentage of females is a little greater than that of the State at large, but smaller than that of Lowell, Lawrence, and some other manufacturing towns.

Occupation.—Of the 8,805 persons who are set down in the census report as being engaged in manufactures and mechanical industries in Lynn, 5,689 are employed in some branch of shoemaking. These figures are supposed to include the working men and women alone. No other business requires the services of one-tenth part as many persons. The manufacture of morocco comes nearest to it, employing 456 men; carpentry next to that, with 445. It is therefore obvious that the chief employment of the people of Lynn, outside of those kinds of labor which pertain to every community, is the manufacture of boots and shoes. Of the number of operatives given above, 1,660 are women. The influence of this occupation, apart from its frequent, but unnecessary, concomitants of badly-drained, -warmed, and -ventilated shops, upon the health of the operatives, is a subject which requires too much research to be discussed within the limits of this paper. The condition of the shops will be briefly considered further on.

Intelligence.—Of the 26,135 above ten years of age, 1,010, a percentage of 3.8, cannot read and write. Of these, 867, or 85.8 per cent., are foreign-born. The native population are, as a rule, fairly educated. The standard of education in the schools is high, and they are well sustained. The percentage of illiteracy is less than half that of the State at large, and but little more than a third that of Boston. This general diffusion of intelligence is another circumstance tending to the production of a relatively low death-rate.

Wealth.—Property is pretty evenly distributed among the people. The wealthy class are few in number, as compared with many other places. The great body of the people may be said to be in moderate, but comfortable, circumstances.

The total valuation, divided, gives \$795 for every person, and \$2,908 for every adult male.

Pauperism.—During the year 1875, the city maintained fully, at the almshouse and elsewhere, 165 persons, including the insane chargeable to it at Ipswich. It also partially supported 2,219 persons at their own homes. The number thus assisted has been larger for a few years past than formerly, owing to the depression of business. Many receive aid only for a portion of the year. The percentage of complete pauperism to the whole population is 0.5; of partial pauperism, 6.8; total, 7.3.

III.—ARTIFICIAL CONDITIONS AFFECTING HEALTH.

Water-Supply.—The water-supply of Lynn is derived mainly from two sources; viz., 1. The wells scattered everywhere throughout the city; 2. Two artificial ponds.

Up to the year 1870, the water used came almost wholly from the former source. The rain-water, collected from the roofs of houses and stored in cisterns and hogsheads, was used chiefly for washing and similar purposes, not for drinking or cooking. Now the pond-water is generally supplied to the thickly settled parts of the city; yet there is a widespread preference for the wells, comparatively few of which have been abandoned. It is safe to say that two-thirds of the people habitually use well-water. In view of the fact, which is thought by medical men to be established, that impure water is a common cause, not only of typhoid fever, dysentery, diarrhoea, and similar diseases, but also of many disturbances of health which have no well-defined character or name, it becomes a serious question for the inhabitants of Lynn to consider, to how great an extent these wells have or may become polluted. The subject is treated somewhat in detail on account of its importance.

Wells.—There are ~~three~~ kinds of wells in use:

1. The ordinary dug well.
2. Driven wells.
3. Borings; sometimes called artesian wells.

The dug wells are by far the most numerous. Of these, the great majority may be described as superficial. As has been shown before, a large part of inhabited Lynn is situated

on an irregular clay bed, covered with loose gravel and sand. It is easy, by digging a short distance in almost any part of the plain, to reach a saturated stratum of earth, overlying the clay. The depth of water in a well sunk into this stratum will vary continually with the season. The water is clear and sparkling, except after heavy rains; but there is nothing to protect it from contamination, when the well is situated in the neighborhood of cesspools, vaults, and filthy refuse heaps, the soakings of which render the earth foul. A portion of the dug wells are sunk below the clay stratum. This may be said to be uniformly the case where the clay comes very near the surface. Another portion of the wells are dug into the rock. These are situated on the hills, or at their foot. The depth of the wells varies from ten to twenty-five or thirty feet. A few go deeper. They are usually stoned up, though some have wooden curbs. Those which are sunk below the clay are less liable to contamination than the others, but they are by no means secure; for leakage may occur above, through the loose wall of the well, unless this is thoroughly backed in with clay or cement,—a precaution seldom taken.

When the clay is near the surface, and the stratum thin, these wells are scarcely better protected than those above the clay; for the neighboring cesspools and privy-vaults are also, quite likely, sunk lower than the clay, and their contents find ready access to the well through the porous substratum. The rock affords no protection, for the water passes freely through its fissures, and does not receive any of the benefit of filtration which is afforded by earth.

The most erroneous ideas in regard to the liability of wells to contamination prevail among the people. Those who are familiar with the principles of underdrainage by means of porous earthen tiles, know that when they are placed in the earth the water will find its way for quite a long distance on either side to them, and through their pores; yet they are only small vacant spaces in the earth, while a well is a large and deep one, attracting moisture from a much greater distance. But, notwithstanding these well-known facts, persons of high intelligence on most points, feel perfectly secure in regard to their wells, with a cesspool or privy within a few feet of them. Below are given illustrations of several badly

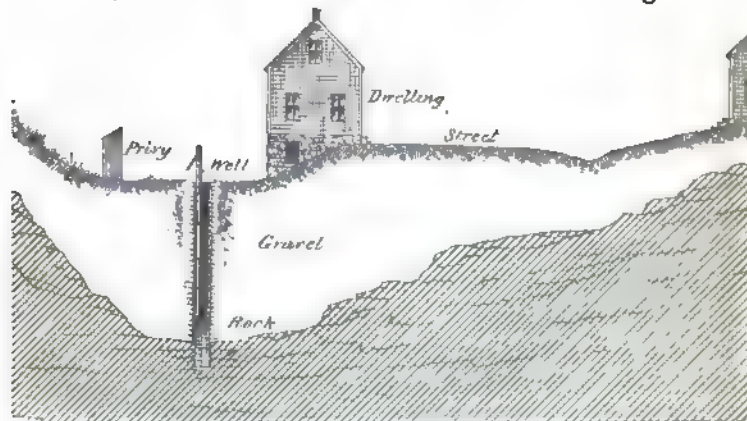
situated and contaminated wells. They are only specimens of many within the writer's knowledge.

No. 1, situated on Friend Street. The privy above has been for some years cleaned out and the contents placed in a trench between it and the well. All about the privy are ashes and garbage from the neighboring house. An analysis of the



water was made by Professor Nichols in 1875. (See Report State Board of Health for 1876, page 254.) A number of serious cases of illness may reasonably be attributed to its use. It is easy to see how it becomes contaminated. During a heavy rain, more especially when the ground is frozen, there is direct surface-drainage into it. At other times there may be soakage from the filthy earth above. The specimen examined was taken when the well was at its best.

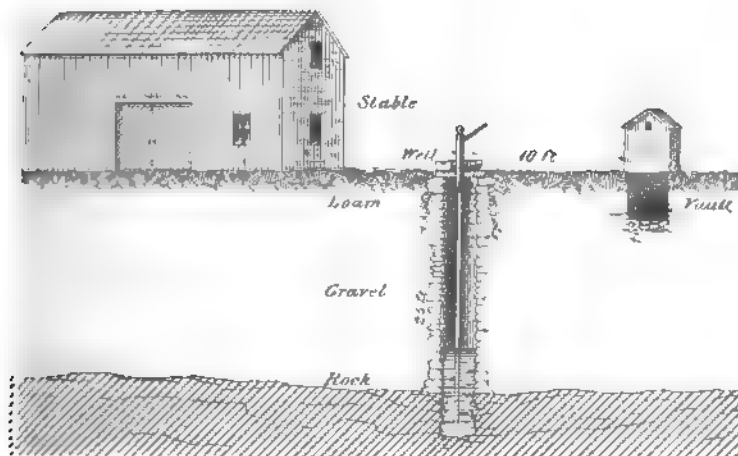
No. 2, situated on Western Avenue. The diagram ex-



plains its position. The soil and subsoil are loose; contamination occurs both by surface-drainage and from soakage.

Five cases of typhoid occurred in 1875 in the family living in the house, and seven more, with one death, among other persons using the water. This house became the centre of infection for a whole neighborhood. An analysis of the water was made by Professor Nichols, which proved it to be highly contaminated.

No. 3, situated on High Street. The well is twenty-five feet in depth, a portion of it being dug into the rock. The vault is ten feet distant on the same level. There is a cess-pool in the garden below, and a stable on the left. The



buildings and well are on a side-hill. The premises are kept clean, and the water, which is clear and of good taste, has been used for many years. The occurrence of typhoid in the family last fall led the physician in attendance to suspect the water. An analysis was made with the following result:—

	Result expressed in parts per 100,000.
" Ammonia (unfiltered),	0.218
Albuminoid ammonia (unfiltered),	0.022
Ammonia (filtered),	0.218
Albuminoid ammonia (filtered),	0.021
Total solid residue at 212° F.,	77.0
Chlorine,	11.6

"Colorless. The large amount of ammonia and chlorine and the total solids show it to be a water bad to drink. The 77.0

parts of solid matter lose 12 (about) on ignition, but it is in large measure due to change of the mineral matter. There is, however, objectionable organic matter present, and a considerable amount of nitrates. The mineral matter is mainly carbonate and sulphate of lime and alkaline salts. On account of the deliquescent character of the residue, it is inferred that some of the chlorine is in combination with calcium, and not all as common salt."

There were five cases of typhoid in the family, and several others, with one death, among neighboring persons using the water.

Enough has been said to show the danger that exists. It would be difficult to set forth the whole danger in terms sufficiently strong, but we may confidently make the broad statement that there is no well of this kind anywhere within the thickly settled portions of the city that is not subject to a possible contamination. When the well is closely surrounded by dwellings and their concomitants, the possibility becomes a probability; in numerous instances an absolute certainty.

The other kinds of wells in use are safer, but they should always be carefully looked after. Driven wells have been polluted by the dribbling of sewage downward along the tube. Artesian wells, so called, are not very numerous. The best example within my knowledge is one on Boston Street, which discharges a constant stream. A well on Mall Street was excavated like an ordinary well for 30 feet, down to the clay; then a boring of 50 feet was made, giving the whole a depth of 80 feet. The water rose to within 15 feet of the surface. It is difficult to see how such a well could be contaminated, except by leakage into the reservoir above the clay. There are several more superficial wells of this kind on Williams Street. After the clay was reached in excavating, a wooden curb was sunk down, the ~~st~~ being driven into the clay. A boring six inches in ~~the~~ ^{the} clay, the water rising to the ~~the~~ ^{the} surface. This occurs now only in the

The liability of these wells on the character of the curb

cement, would be better than wood. The well is far preferable to one of the ordinary kind.

The natural character of the well-water of Lynn, as is usually the case in regions having such geological characters, is for the most part good. Near the level of the sea, however, it is apt to be brackish.

The water from the two ponds referred to above has undergone some fluctuations in quality during the short period that has elapsed since its introduction, depending partly on the newness of the works for storing and distributing it, and partly upon some unexplained natural causes; but it now gives better satisfaction than formerly. It is somewhat colored; and many complain of it on this account. It is supplied to about one-half the inhabitants of the city; but it is estimated that not more than one-third use it for drinking and cooking. Breed's Pond was originally constructed in 1842, and improved for public use in 1870. Birch Pond was constructed in 1873. The surface from which the water is collected is admirably adapted for that purpose, being of a sterile, rocky nature, and uninhabited. The total daily capacity of the two ponds is 1,500,000 gallons. This is less than was at first estimated; but the fact had not then been ascertained that the average rainfall of the district is less than that of Eastern Massachusetts, which was taken as the basis of calculation.

The average number of gallons used daily by each consumer is 74.48. This is a large amount when compared with the English supply, but considerably smaller than that of some other American cities. The growing wants of the city render it necessary to increase the amount stored; and the important question is presented as to whence it shall be derived. The natural lakes of Lynn, briefly described on page 172, have been strongly urged as a source. The natural quality of the water is excellent; but the objection is raised that the ponds are situated in the midst of a constantly increasing population, the drainage of which they in a measure receive, and that there is a large cemetery, also growing, upon their water-shed. These facts render a contamination of the waters a matter of extreme probability, unless great expense is incurred to protect them. And the fact is brought

forward that if this should be done, the diversion of the surface-water would diminish the supply in proportion. The fear of serious pollution from the villages on the borders of these ponds is not an idle one, as is proved by the experience of several German cities. (See American translation of Ziemssen's *Cyclopedia of the Practice of Medicine*, Vol. I., p. 59.) The poison so conveyed through water, and so deadly in its effects, is not discoverable by chemical or microscopical tests.

The alternative is presented for the city to increase its supply by an extension of the plan which has been already adopted. In regard to the propriety of this course, there is a division of sentiment among the people. To one examining the subject from a non-partisan standpoint, it would seem to be altogether the safest course to pursue.

Sewerage.—Next to the subject of water-supply in importance, is sewerage. The work of constructing sewers in Lynn was begun in 1866, and has gone steadily but slowly onward since. There are now nearly seven and a half miles in a total of 89 miles of streets. Many of the streets partake of the character of country roads to so great a degree as not to require sewerage. In the crowded parts of the city there is an urgent demand for its extension. So far as any effect of the sewers already constructed upon health has been observed, it appears to be altogether favorable. The problem of determining this effect, however, is so complicated, that the statistics at present available do not suffice for its exact solution. But aside from any reduction of mortality that may have been effected, it is safe to credit the sewers with doing a considerable amount of good; for—

1. They have rendered the soil of the streets containing them drier, by establishing a more effective surface-drainage, and by their action as underdrains.

2. They have abolished a large number of cesspools.

Every private drain entering a sewer does away with the necessity of a cesspool; and so affords more security to wells, and protects the soil from contamination.

3. By improving the general appearance of the streets, they have stimulated the residents to greater care of their premises as regards cleanliness. This fact is strikingly observable in Sagamore, Beach and Pleasant streets.

But there is one prominent defect in the sewers which demands attention. This is the lack of provision for ventilation. The sewer constructed during the past season in Baltimore Street is ventilated through the catch-basins, an eight-inch hole being made in the central division of the trap. There is now considerable complaint of bad odors arising from the catch-basins in the streets, and the experiment will probably have to be abandoned. All the other sewers are unventilated. In a few instances water-spouts enter private drains, and so afford a sort of ventilation to the sewer; but the experience of other cities has not been such as to warrant any dependence being placed upon this method. The outlets of the sewers are such that they are exposed to the full force of strong winds. In this way there is reason to suppose that the traps of sinks and water-closets have been forced and the sewer-gases driven into the houses. The same result is thought to have occurred during a heavy fall of rain, when the mouths of the sewers were tide-locked. Only one outlet, viz., that of the Shepard-street sewer, and those connected with it, is so situated as not to be filled by the tide.

This grave defect in the sewers, it is to be hoped, the city will remedy before, like Croyden, in England, it is taught wisdom by the occurrence of a destructive epidemic. The manner in which the sewage is disposed of is, prospectively, an evil of great magnitude. It is all discharged into the harbor or on the flats. When it is remembered that the harbor is for a portion of the time nearly emptied of water, it will be seen how dangerous this process is. The accumulation of silt or sewage-mud is going on at a rapidly increasing rate as the sewerage is extended. When the wind is from that direction, and the tide out, there is a very strong and disagreeable odor perceptible in the higher parts of the city. It has been suggested that the sewage should be diverted from the harbor and carried across the marsh to Saugus River. Two objections present themselves to this plan, perhaps not insuperable ones, but certainly to be considered.

1. The distance across the marsh is so great that it would be difficult to give the sewer a sufficient fall to ensure its being kept free from deposit. This might be remedied by pump-

ing; but here the expense is an obstacle not to be disregarded in these times.

2. The sewage-mud might be swept around and left on Revere Beach, or carried up the river by the tide. In either case parties damaged would have a right of action.

Another plan proposed is to carry the sewers out far into the harbor. It is not easy to see how this could be effected, except in connection with some comprehensive scheme to fill in a portion of the harbor and dredge out the rest of it. The outlay for this would be immense. It is not probable that the sewage could be carried across into Nahant Bay without pumping; and if it were so carried, it might spoil Long Beach. The alternative of "sewage-irrigation" remains. But there is no suitable land accessible without pumping, and hardly with. Altogether, the problem of disposing of the sewage in Lynn is one of great difficulty, which can only be solved by skilled engineers.

House-Drainage.—As only 415 drains, in all, connect with the sewers, there being 5,442 occupied dwelling-houses in Lynn, to say nothing of the numerous shops and other buildings requiring drainage, more than nine-tenths of the sewage must be allowed to run on the surface of the ground, or into some sort of a cesspool. Any estimate of the amount running directly on the surface would be guesswork, and of little value. Suffice it to say, that the practice of discharging house-drainage on the surface is not unusual in the outskirts of the town, where the sink-holes under the back windows are as successful in arresting the attention of the sanitary inspector through his olfactories as they are wont to be in purely rural districts. Sometimes the drainage runs into privy-vaults, but this is rare. The most common kind of cesspool is a bottomless cask or hogshead, set in the ground and covered over, first with plank and then with earth. Another kind frequently used has an uncovered bottom, open stone sides and vaulted brick top. This may be said to be the cesspool in general use in connection with the better class of houses. Some few are cemented and supposed to be watertight. The frequent necessity of emptying these, however, renders them unpopular. Where the soil is sufficiently porous to allow the liquid to soak away at all times, the cesspool is

not cleaned out until nearly or quite full of sediment. Out of several thousands of cesspools which exist in the city, only twenty-eight were emptied by the city contractors in 1874, twenty-nine in 1875, and twenty-five in 1876, up to August 25. As less than one-tenth part of the families, shops, etc., supplied with the city water have drains connecting with the sewers, it follows that of the 470,000,000 gallons, more or less, annually consumed, upwards of 420,000,000 gallons are absorbed by the earth in the thickly settled parts of the city. The reader can form his own estimate of the probability of any portion of this water, polluted as it is with offensive organic matter, finding its way into the thousands of wells scattered over the same territory.

House-drains are seldom either trapped or ventilated. The ordinary dwelling-houses have no traps to their kitchen-sink waste-pipes. The water-closets in town are mostly of the "Bartholomew" pattern. It is the usual custom to trap the soil-pipe with a half or full S bend, and then connect with this, without separate traps, the waste-pipes of bath-tubs and wash-bowls on the same floor of the house. Many are introducing the galvanized iron seat ventilators, with good results. A prominent plumber declared to the writer, that if the principles set forth in the article on "House-Drainage," in the last report of the State Board of Health, were correct, there was not a house in Lynn in which the provisions for drainage were perfect. This we can easily believe to be the case, for defects abound everywhere. That they are not more operative for evil, is due to the absence of crowding, and other sanitary advantages which this city possesses in common with others of its size. These advantages are rapidly disappearing as the population increases and filth accumulates about the dwellings.

Surface-drainage.—So far as the streets are concerned, this point is being carefully looked after. A great amount of grading has been done during the last ten years; and much improvement is manifest. The work is still going on, and will, in due course of time, be complete.

Underdrainage.—No systematic attempt seems ever to have been made to deprive the soil of Lynn of any portion of its superabundant moisture. The result has been indirectly attained in some instances by grading to facilitate surface-

drainage, thus diminishing the supply which the ground receives, and by the construction of brick sewers, which, as before stated, act in some measure as porous tile-drains. But outside the limits of these improvements, the soil is, for the most part, in its original state of dampness or dryness. It is true that wells, and even cellars, may act as receptacles for the water, and cause the soil about them to be somewhat drier; but this can hardly be considered an advantage, in a sanitary point of view. Some of the marsh lands have been diked and ditched, in order that they might be cultivated. Thus it is seen that the idea of "drainage for profit" has occurred to some of our people, but I am not aware that that of "drainage for health" ever has. In the damp districts, some of the cellars are provided with wooden or stone drains, the principal object of which is to carry off the water that collects during heavy rains. The result of the general inattention to underdrainage is a great prevalence of damp cellars. The dampness is not equally obvious at all seasons of the year, but is most strikingly manifest during the fall and spring, when the ground is soaked with water, and the protective agencies of frost and sunshine are not actively at work. Statements going to prove the unhealthiness of the damp districts will be given further on.

Drainage of Factories.—The drainage of shoe factories does not differ essentially from that of ordinary dwellings, and requires no separate mention. Factories for the manufacture of morocco, glue and soap are characterized by an offensive sewage, the disposal of which is a matter of some sanitary importance. There are twenty-four morocco factories in town, discharging their sewage as follows:—

Fifteen drain through the sewers, or directly into the harbor.

Two large ones, on Market Street, allow the greater part of their liquid waste to run into a creek in the rear of the shops, between Market and Pleasant streets and the two railroads. From thence the overflow finds its way through a wooden drain into the Pleasant-street sewer. The creek was once the lower part of the brook which ran down from Munroe Street. It was cut off by the Market-street sewer. One of the aforesaid factories has a drain entering the Market-street sewer; but having too slight a fall, it becomes clogged,

and practically inoperative. The creek is extremely filthy; and although it is claimed by morocco manufacturers that the sewage of their shops is not prejudicial to health, on account of its lime and other constituents, which act as disinfectants, it may be seriously questioned whether such sewage, stagnant and decomposing under a hot sun, does not develop gases dangerous to health. At any rate, Pleasant and Harbor streets, notorious for their unhealthiness, are near this creek.

Two morocco factories drain into Strawberry Brook, in the neighborhood of Waterhill Street. The sewage runs at intervals into the lower brook, which is occasionally flushed from the upper brook to secure cleansing. The upper brook usually conveys the principal part of the water to the mill-pond. Between Boston and Waterhill streets, Strawberry Brook is made offensive by this sewage.

One or two morocco factories drain into the upper end of Flax Pond.

One glue factory drains into Stony Brook, above Boston Street. Parties living near say that the brook is very offensive in summer.

Another glue factory is situated on the low land, between Harbor Street and the Revere Beach Railroad. There is a drain which carries off the surplus water of the grounds into a trench by the side of the railroad. From thence a portion of it probably finds its way into the mill-pond. The ground is soaked with filth; and there are offensive, stagnant pools about and under the buildings.

Two soap factories (bone-boiling establishments) situated on Chestnut Street, drain into Bog Meadow. There is much complaint, in the neighborhood, of the disagreeable odors proceeding from these factories; no deleterious influence upon health, however, has been demonstrated. The neighborhood is sparsely settled. The meadow in the rear of the factories is very foul.

One soap factory, upon Lake Street, drains into a vat. This is filled with loam, which is removed from time to time, and used as a fertilizer.

Night-Soil.—Night-soil is either washed away, by means of water-closets and drains, into cesspools and sewers, or allowed to accumulate under privies. The privies are of

varying construction. Some are destitute of vaults ; others are placed over shallow pits. Still others have rudely constructed vaults, stoned or planked up at the sides, with uncovered bottoms. The stones and planks are only intended to guard against the caving in of the sides, not to prevent the liquid contents of the vault from soaking away into the earth. A few privies have vaults of brick or stone, cemented at sides and bottom, and designed to be water-tight ; a condition which they often fail to attain. The great majority of the privies are connected with some shed or out-building, from a few feet to as many rods from the dwelling. Some are in immediate contact with the house, so that leakage from the vault into the cellar has been known to occur. No satisfactory provision is made for the cleansing of privies and the removal of night-soil from the city. Except in some rare instances, in which complaint is made to the police authorities, of privies as being in such an offensive condition as to constitute them intolerable nuisances, the matter of keeping them clean is left to the dictates of individual indifference and cupidity, or the opposite.

A city ordinance requires that the work of cleansing vaults and cesspools shall be performed by persons whom the city appoints, at fixed prices, and under prescribed conditions ; but only those who make application have their wants attended to, and then it is at their own expense. The contractors are put under bonds to do the work faithfully, to employ a water-tight cart, to work only at night between certain hours, to leave the premises in good condition, and to remove the night-soil either entirely without the city limits, or to such places within as the authorities may designate. How inadequate these provisions are for the necessities of the case, will be seen by the following facts. The number of dwelling-houses in Lynn, occupied and unoccupied, is 5,532. Many of these are of two tenements, for which separate privies or water-closets are provided. There are 984 water-closets, 178 of them being in factories. There are 32 houses with two water-closets each. Making the necessary deductions, we have left 4,758 houses supplied with some sort of a privy. This is a moderate estimate ; the number being probably greater. Of this number, there were cleaned out by the contractors in

1874, 468; in 1875, 359; in 1876, up to August 25, 346. Many of these had not been cleaned out for several years previously; some had gone as long as five years. Thus it will be seen that less than ten per cent. of the privies are annually cleansed under the supervision of the health authorities.

In the outskirts of the town and elsewhere, those who have gardens are in the habit of using the night-soil as a fertilizer. Not a few bury it in a trench near the privy. During the year 1876, the night-soil has been carried into the extreme eastern part of the city, and placed, a portion of it in pits and carefully covered with muck, another portion directly on the surface, uncovered. The odor from these pits and heaps was very troublesome to people living near during the hot weather. It was in this neighborhood that diphtheria was most prevalent throughout the summer months, at a time when, in all other portions of the city, it had in great measure abated its ravages.

Garbage.—The garbage or refuse of the kitchen, which goes by the name of "swill," is collected chiefly by boys, in pails and carts, for the purpose of feeding swine. No supervision whatever is exercised over these boys by the city authorities, but they are allowed to come and go as they will, and to use the sidewalks as highways for the transportation of their disgusting freight. They are accustomed to leave their carts in front of dwellings, under the noses of the residents and passers-by, while they are engaged in searching for the swill or in more reprehensible employment. The evils connected with this system, or lack of system, are various. In the first place, it encourages the poorer classes of the city in the practice of raising swine; and, as a consequence, the filthy pens in which these animals are kept abound in some sections. In the second place, the garbage is not always thoroughly removed. It is usually placed in some open receptacle, as a firkin or box, by the occupant of the house. This vessel, although emptied once a day, or less often, by the swill-boy, is seldom cleaned, and hence becomes foul. In some places the garbage is thrown upon the ground in a corner of the yard with other rubbish. In such cases the swill-boy picks up what he conveniently can, the rest being left to putrefy and poison the air of the locality. The evils arising from a

defective removal of kitchen refuse, are manifest in proportion as people are ignorant and careless of sanitary laws.

Dry Refuse.—The dry refuse of dwellings, such as ashes, broken crockery, old boots, and other kinds of rubbish, mixed often with a certain amount of putrescible matter, is now removed by the teams of the highway department, on being placed at the edge of the sidewalk, in barrels or heaps, by the occupant of the house. The practice was established several years since by Hon. Hiram N. Breed, then surveyor of highways, and has resulted in much improvement in the general appearance of the city. Were the moist refuse or swill removed in an equally systematic and thorough manner, the benefit resulting would be great. The refuse collected as above has been used for filling in at the wharves and elsewhere in the city; a practice of which little can be said in commendation.

Piggeries.—Of the abodes of the different domestic animals, those of swine are most deserving of mention, from their intimate connection with dwellings, and their offensiveness. The ordure which accumulates in them is usually employed as a fertilizer on some neighboring garden-patch. The fact that they are most numerous, and in the closest connection with dwellings, in the unhealthy sections of the city, may be taken as proof of their evil influence.

Dwellings.—In the character of its dwelling-houses, Lynn does not differ materially from other cities in New England. The most of them are of wood, and so scattered over the abundant space afforded, that in very few localities can they be said to be crowded. But in common with dwellings almost everywhere, they have certain faults, pertaining either to site, construction, or management.

1. *Site.*—In regard to site, the principal defect is that they are too often built upon wet land. This is especially true of many constructed within the last ten years; instances being observable on the low lands surrounding Bog Meadow on the north and east, along the course of Stacey's Brook, and on the borders of the marshes. It seems almost criminal to allow such places to be occupied for habitations, without being drained, when there is so much land not open to such objections remaining to be taken up.

2. *Construction*.—Aside from points which have already been incidentally alluded to under other heads, the chief fault in the construction of dwellings consists in the lack of provisions for a constant supply of pure air. A few houses have openings for ventilation in the chimneys, or have separate flues or shafts for this purpose; but the greater number have no means of ventilating except through doors and windows. When the latter let down at the top, and the matter has intelligent care, the dwelling may be kept well supplied with such air as the city affords, which, in view of what has been said of the condition of privies and back yards in some quarters, may well be supposed to be not always of the best. Owing, probably, to the fact that the impurities of the air are not manifest to the sense of sight, and seldom to that of smell, and to the fact that their ill effects are such as to mislead in regard to their cause, there is a degree of popular neglect of ventilation that is discouraging to the sanitarian. The dampness of the air in dwellings is another point that requires mention. Many that are situated on a porous and well-drained soil have damp cellars and apartments, for the simple reason that the roof leaks or the water runs into the cellar at every rain. In this way, owing to faulty construction, the dwelling may be as unhealthy as though situated on a marsh.

3. *Management*.—By this term is meant, chiefly, care as regards cleanliness, and the proper use of the means afforded for ventilation. The greatest difference is observable. In general terms, it may be stated that the death-rate of different sections and streets varies just in proportion to the intelligence and vigilance of people in keeping themselves and their surroundings, the air they breathe and the water they drink, free from filth. The best natural advantages and most perfect construction of the dwelling, are of little use without this care.

Shoe-shops.—The shoe-shops of Lynn are now to be considered briefly, with reference to their arrangements for ventilation, drainage, warmth and light. They are all, as a rule, well lighted, this being a necessity of the work. In the matter of warmth, there is probably little room for complaint. It is stated, however, that some are kept too warm in winter,

the workmen being thereby rendered liable to take cold on going out. Drainage is generally good; inasmuch as the greater number of shops are situated on streets containing sewers, of which the owners can avail themselves. The water-closets, with which the shops are frequently supplied, are extremely prone to get out of order, and to be, consequently, in a filthy condition. There is an almost universal absence of any adequate means of ventilation. Below are given descriptions of two of the larger shops, which may be taken as representatives of the whole.

No. 1. The building is eighty feet long by fifty wide, and consists of a basement or cellar, and four stories. The means of ventilation are the windows, doors, and the elevator, situated nearly in the centre of the building. This is in use much of the time, and allows of considerable circulation of air. There is, however, no escape at the top. The maximum number of hands employed in the shop is one hundred and seventy-eight. The estimated cubic space for each hand is eleven hundred and fifty-one feet. The space afforded for each person is seen to be ample, provided the air be changed often enough. According to best authorities, about three times per hour would be required in order to ensure purity. When this fresh supply is left to the chance opening of doors and windows, it may well be believed that during cold weather the air is not at all times good. There are nine water-closets in the building with a direct supply of water. Those on one side of the building enter one main soil-pipe, which extends upward to the roof, and receives the water from thence at its open end. Beneath the shop it enters a drain, into which the soil-pipe of the other water-closets enters also. Thus it will be seen that all the water-closets are furnished with ventilation. They are not, however, in good working order. The general appearance of the shop is cleanly.

No. 2. The building is old, and consists of two parts, one of which has five floors, and the other, four. The windows are numerous and small. In addition to the usual means of chance ventilation, there is a wooden ventilating-shaft, about fifteen inches square, in transverse section, for the two upper stories, and a scuttle in the roof. The basement contains a

stagnant pool of water under the floor, visible where the latter is broken. There are seven water-closets and one urinal, all of which are somewhat offensive. The drainage is into the sewer. In some of the rooms the air was close and bad. Estimated cubic space for each workman, eight hundred and fifty feet.*

The proprietors of the shoe-shops, so far as my experience has gone, have shown the utmost readiness to assist in the inspection, and to allow errors to be pointed out. No satisfactory statistics bearing on the causation of disease by the defective construction and management of shops are at present available.

Intemperance and Immorality.—The amount of intemperance in Lynn, as compared with other places, cannot readily be ascertained. We know the annual number of arrests for drunkenness, the number of intoxicated people helped home, etc., but these figures are only the reflex of the activity, or otherwise, of the police authorities, and give no adequate idea of the extent to which intemperance prevails among the people. But among certain classes of the community, and in certain localities, this vice is a very common one, and it is universally recognized by our physicians as a potent cause of disease and death. In regard to immorality, although it cannot be doubted that there is a general relation between the prevalence of all forms of vice and of disease, yet the subject is presented to the mind of the student of public hygiene chiefly as a cause of venereal disease, and as leading to the practice of criminal abortion. The former cannot be said to be more prevalent in Lynn than in other manufacturing towns. The practice of criminal abortion is frequent. Its effects are the impaired, often the hopelessly ruined, health of the mothers, and a general lowering of the moral tone of society. This melancholy confession can be slightly relieved by the statement, that in the opinion of some physicians the practice has lessened of late years, and that there is manifest an improved sentiment in regard to it among the better classes of the community. Others are hardly willing to make even this admission.

* The defects in this shop, as regards drainage and the means of ventilation, have been remedied, in a measure, since the visit was made.

IV.—RATES OF MORTALITY.

Having thus far described the population and pointed out the conditions, natural and artificial, which influence the healthfulness of the same, it will be next in place to determine the results of these conditions, and to give them as far as may be numerical expression.

The annual death-rates of the whole city for the past twenty-five years are exhibited below. The calculations were all made from original data, the population being estimated in the manner indicated on page 180 for all years except those in which a census was taken.*

Annual Death-rate of Lynn for Twenty-five Years (1851-75, inclusive).

Y E A R S .					Number per 1,000 of Population.	Y E A R S .					Number per 1,000 of Population.
1851,	.	.	.	.	16.8	1864,	.	.	.	.	21.7
1852,	.	.	.	.	17.9	1865,	.	.	.	.	22.1
1853,	.	.	.	.	18.3	1866,	.	.	.	.	18.
1854,	.	.	.	.	16.8	1867,	.	.	.	.	16.2
1855,	.	.	.	.	20.8	1868,	.	.	.	.	17.9
1856,	.	.	.	.	17.8	1869,	.	.	.	.	18.3
1857,	.	.	.	.	17.2	1870,	.	.	.	.	17.2
1858,	.	.	.	.	17.9	1871,	.	.	.	.	19.9
1859,	.	.	.	.	17.1	1872,	.	.	.	.	24.5
1860,	.	.	.	.	17.7	1873,	.	.	.	.	22.1
1861,	.	.	.	.	20.3	1874,	.	.	.	.	18.6
1862,	.	.	.	.	18.5	1875,	.	.	.	.	19.4
1863,	.	.	.	.	20.3						

The mean rate for the whole period is 19.1. As will be observed, the maximum rate, 24.5, was attained in 1872, and minimum, 16.2, in 1867. The former was a year of unusual mortality throughout the State, and the latter one of uncommon exemption from fatal disease.

In accordance with the established custom, still-births have been omitted in determining these rates. There seems to be no good reason, however, for such a course, inasmuch as the number of dead-born children in any community shows to a

* The estimates given in the Massachusetts Registration Reports are inaccurate, except as to the census years; the rates of mortality generally appearing too high. In the general abstracts the reverse is the case. The latter are not available for a comparison of different towns, owing to widely varying rates of increase.

certain extent the degree of diffusion of syphilis, scrofula and similar causes of feebleness in offspring; while the somewhat rare instances in which vigorous children perish during birth from difficult labor or some accidental complication, are just as properly included in the estimates as are the deaths from drowning, injury, or other forms of violence.

There is reason to suppose that the value of our figures is somewhat vitiated by imperfect registration. The remark is the more applicable as we go back in time. But although we can surmise an incompleteness of the registration from failure of the undertakers to make due returns, or other cause, we cannot from the nature of the case demonstrate it. We know, however, that a certain number of persons are buried and their deaths recorded in Lynn, who lived and died in other towns. We may presume, too, that some who died here are buried in other places, where, also, their deaths are recorded. The effect of these two kinds of error upon the death-rate is precisely opposite. It is fair to assume that they about balance each other. No exact correction is possible. It is well known, also, that many of the working people of Lynn, transient residents as they are, acquire disease of a fatal character here and go to their country homes to die; thus relieving the city of a large annual addition to its mortality list. On the whole, it may be stated, that the death-rate of Lynn appears somewhat lower than it would if all the facts bearing upon it were obtainable. But the same sources of error probably exist in all the towns of the Commonwealth; so that a comparison with them will be just.

The accepted average death-rate of Boston is 24.5 per thousand of the population.* This is 5.4 more than that of Lynn. But the overwhelmingly greater size of the former city makes the comparison of less value than it would otherwise be. I therefore subjoin a table showing the death-rates for ten years of eleven cities of Massachusetts, having, by the census of 1875, over 20,000 inhabitants. The data are taken mainly from the Thirty-Third Registration Report of Massachusetts, p. cxvi *et seq.* But the rates there given are rejected as being too low; the results of the census of 1875 being taken as a basis of computation, instead of the mean

* See Report on the Sanitary Condition of Boston, by Dr. T. B. Curtis, 1875.

population, as estimated for the ten years. I have employed the arithmetical mean of the population for the two census years 1865 and 1875. This does not differ sufficiently from the true mean to make any appreciable error in the rates. The rate for the State at large, and, as a matter of especial interest in this connection, those of the neighboring towns which once constituted a part of Lynn are stated. The birth-rate for the same period is also given, inasmuch as it is sometimes asserted that it is the "controlling element" of the death-rate; a statement which is here seen to be fallacious.

	Population in 1875.	Death-rate.*	Birth-rate.*	Difference.*
Lynn,	32,600	19.4	26.7	7.3
The State,	1,651,912	19.2	26.2	7.0
Worcester,	49,317	22.4	32.9	10.5
Lowell,	49,688	22.2	23.8	1.6
Fall River,	45,340	21.8	27.7	5.9
Salem,	25,958	20.4	16.8	—3.6
Cambridge,	47,838	20.0	30.8	10.8
Somerville,	21,868	19.6	33.2	13.6
Lawrence,	34,916	19.1	30.6	11.5
Springfield,	31,053	18.9	27.5	8.6
Chelsea,	20,737	18.8	26.6	7.8
Taunton,	20,445	17.6	26.4	8.8
New Bedford,	25,895	17.3	19.5	1.2
Lynnfield,†	769	16.3	19.9	3.6
Saugus,†	2,578	15.4	17.7	2.3
Swampscott,†	2,128	15.2	25.4	10.2
Nahant,†	766	11.7	28.0	16.3

By this table it will be perceived that there are five cities of more than twenty thousand inhabitants in Massachusetts whose death-rates are lower than that of Lynn, and six whose death-rates are higher. Somerville and Lawrence differ only by two- and three-tenths, respectively. Some of our little neighbors are so far above us in healthfulness that a comparison seems almost odious. The great lack of correspondence between the birth- and death-rates in this table is a matter for observation. How far differences in the care with which births and deaths are registered will account for the remarkable variation here shown, I do not undertake to say. We may

* Mean of the years 1866 to 1875, inclusive.

† Formerly Lynn.

conclude that the position of Lynn, as to healthfulness, among the cities of the State, is a medium one ; it does not make the best showing, while it is very far from making the worst.

Mortality at Different Ages.—There is no more accurate test of the sanitary condition of any place than the mortality among its children. Those of tender age are almost constantly at home and exposed to whatever causes of disease may be localized there. Their systems are very susceptible to the influences of bad air, water and food. In the transition state of any town from the comparative salubrity of a country village to the unhealthy conditions of an urban community, children are the first to feel the change. They are the advance guard, first under fire from the forces of disease, and suffering most severely. We have seen that the general death-rate of Lynn is not very high as compared with other places. We will now analyze this rate, to see if any one age contributes more or less than its share. As our principal object in the inquiry is to ascertain how the children are affected, the rates are given for three groups only ; viz., those under one year, those under five, and those over five. In the first table, Lynn is compared with Boston and with the State at large, for the two census years 1865 and 1875. The census of 1870 did not give the age-distribution of Lynn.

Deaths per 1,000 at Specified Ages.

						1865.	1875.	Mean.
LYNN, .	{	Under 1,				211.2	251.7	231.4
		Under 5,				79.0	73.1	76.0
		Over 5,				15.5	12.8	14.1
		All ages,				22.1	19.4	20.7
BOSTON, .	{	Under 1,				265.5	275.8	270.6
		Under 5,				92.9	86.8	89.8
		Over 5,				15.6	18.8	17.2
		All ages,				23.6	26.1	24.8
THE STATE,	{	Under 1,				205.2	226.5	215.8
		Under 5,				68.7	77.7	73.2
		Over 5,				14.9	14.8	14.8
		All ages,				20.6	21.1	20.8

From this table we see that the mortality among children in Lynn is less than in Boston, but considerably greater than in the State. The rate among children under one is greater in 1875, a year of average healthfulness, than in 1865, when the general rate was exceptionally high. This leads us to infer that the death-rate among infants is increasing. If any further proof of this statement is required, it can be obtained from a consideration of the percentage of deaths under one to births. They are given for two successive quinquennial periods in the following table:—

Y E A R .	Percentage.	Y E A R .	Percentage.
1866,	15.1	1871,	24.7
1867,	16.1	1872,	25.6
1868,	13.6	1873,	20.7
1869,	20.1	1874,	16.7
1870,	19.5	1875,	18.2
Average, . . .	16.9	Average, . . .	21.2

The difference in the averages for the two periods is 4.3. The average number of deaths under one to the whole population for the first period is 4.5; for the second period, 5.5; a difference of one. The average number of deaths under five for the first period is 6.7; for the second period, 8.1; a difference of 1.4. Although the general rate of mortality is much higher for the second period, yet the increase is disproportionately large for the ages under five.

Mortality of Natives and Foreigners compared.—As in other cities of the Commonwealth, so in Lynn, the rate of mortality among those of foreign parentage is decidedly greater than with the native stock. The special enumeration of the population of Lynn, made for the State Board of Health, has enabled me to institute a pretty exact comparison in regard to this point. Those of mixed parentage have been reckoned as natives, and their deaths so regarded. For this reason the statement of difference in mortality may be considered rather under than over the truth.

Y E A R .	Death-rate among those of Foreign Parentage.	Death-rate among those of Ameri- can Parentage.	Difference.
1871,	23.4	17.2	6.2
1872,	28.9	21.7	7.2
1873,	23.9	19.9	4.0
1874,	20.4	16.5	3.9
1875,	24.2	15.7	8.5
Mean,	24.1	18.2	5.9

If the calculation is carried back still further, the same difference appears. I have assumed that the proportion between the foreigners and their children is the same for the successive years, and taking the average annual percentage of increase, have estimated the number for each year. It may be asserted by some that the higher death-rate among the foreigners is due mainly to a higher birth-rate, which furnishes a greater number of victims for infantile disorders. That there is a basis of truth for this assertion cannot be denied ; yet a reference to the following table will show, that while in regard to past years, the explanation may account for a part of the difference in mortality, yet it cannot for all, and that recently it fails altogether :—

Y E A R .	Native Birth-rate.	Foreign Birth-rate.	Difference.	Diff. between Native Birth- and Death-rate.	Diff. between Foreign Birth- and Death-rate.
1871,	20.0	27.3	7.3	2.8	3.9
1872,	25.8	38.3	12.5	4.1	9.4
1873,	24.7	33.7	9.0	4.8	9.8
1874,	23.8	28.5	4.7	7.3	8.1
1875,	23.1	27.4	4.3	7.4	3.2

- It is here shown—
1. That the difference between the native and foreign birth-rate has steadily diminished for the past four years.
 2. That while the natural increase of the natives (*i. e.*, the difference between the birth- and death-rates) is increasing, that of the foreigners is diminishing.

3. That for the last year of the period covered, the natural increase of the natives has been more than double that of the foreigners.

But if the difference in the birth-rates of the two classes does not account for the difference in mortality observed, what are the causes? I think they may be summarized as follows:—

1. A very general selection by foreigners of the most unhealthy spots as places of residence.

2. A less intelligent appreciation by them of the laws of correct living, as regards cleanliness, ventilation, temperance, etc.

I do not believe it can be truthfully asserted that there is an innate proclivity to disease in any one of the races making up this foreign population, sufficient to account for the relatively great mortality among them.

Mortality of the Sexes compared.—The death-rate of females in Lynn appears to be somewhat lower than that of males. From 1866 to 1875, inclusive, the number of deaths per thousand was: among males, 20.9; among females, 19.4, or 1.5 less. The lower rate of mortality among females, taken in connection with their greater numbers, explains, partially, the low general rate of the city.

Normal Death-rate.—I have calculated the so-called "normal death-rate" of Lynn for the two census years 1865 and 1875, making use of the United States life-table, with the following result.

In 1865, the normal death-rate was 20.7; the actual being 22.1, or 1.4 more. In 1875, the normal death-rate was 20.7; the actual being 19.7, or 1 less. This normal death-rate is of little value, owing to the prodigious guesswork which forms the basis of the United States life-table.

Some English authorities have assumed a death-rate of seventeen per thousand as normal. The appropriateness of this term may well be questioned. Strictly speaking, the normal death-rate will only be attained when all die of old age. That such a millennial freedom from disease will ever be reached by the human race is not to be believed. Yet it were well to aim for the ideal standard of healthfulness, and not for some lower one misnamed the "normal."

V.—PREVAILING DISEASES.

The prevailing diseases of any locality may be considered as belonging in two general classes. First, those which frequently produce a fatal result; and second, those which rarely or never do so. The degree of prevalence of the fatal class can be ascertained approximately by consulting the record of deaths. But here we are met by such palpable and constantly recurring instances of erroneous or incomplete diagnosis, that the statistics are almost valueless for a comparison of diseases among themselves. But, as this is the best source of information we have, we must avail ourselves of it, bearing in mind its probable errors.

The degree of prevalence of non-fatal diseases can only be determined by consulting physicians, and others, who have means of observation. No statistics are available; but the general conclusions may be considered nearly as reliable as those concerning the fatal diseases.

Following the nosological arrangement which has been adopted for the registration of diseases in Massachusetts, it is found that for the last ten years the different classes are credited with the following percentages of the total mortality in Lynn :*—

CLASS I.—Zymotic diseases,	26.4
II.—Constitutional diseases,	27.6
III.—Local diseases,	24.7
IV.—Developmental diseases,	18.4
V.—Violent deaths,	2.9

The most important of these classes, from a sanitary point of view, is the first, for the reason that it contains so many of those diseases which are, to a greater or less degree, preventable. These will now be considered in detail, beginning with those which occasion the greatest amount of mortality, and following the order downwards. As is customary with writers now, diarrhoeal diseases are grouped together. All the deaths but seventeen in the class belong to the miasmatic order.

* These percentages are of all deaths for which a cause is assigned. In the "unknown" class are included "*Hemorrhage*" and "*Tumor*."

Diarrhœal Diseases.—These have been reported in Lynn under the names of cholera infantum, dysentery, diarrhœa, and cholera morbus. The first named has produced nearly four times as many deaths as all the others combined. Together they stand credited with 631 deaths in ten years (1866 to 1875, inclusive); a percentage to the total mortality of 11.2, and to the zymotics of 42.4. The mean number per 1,000 of the population for the period named is 2.26. This is greater than the rate which obtains in the State at large, and but little below that of London. It is probable that the larger number of those cases which are reported as "canker," and are reckoned in the class of constitutional diseases, belong here. The same is true of many other infantile disorders of nutrition, which appear in the record of deaths as "infantile," "teething," "convulsions," and some of those called "consumption." It is customary with many people to designate a disease by its most prominent final symptom, whether that be an apthous sore mouth ("canker"), wasting of the body ("consumption"), convulsions, or other manifestation. The above is one of the sources of error in our registration which has been before alluded to. As is usually the case, the great majority of the victims of diarrhœal diseases are children.

Typhoid Fever.—Under this head are included, beside those cases reported as "typhoid fever," one case reported as "typhus fever," two as "bilious fever," six as "gastric fever," and thirty-three as simply "fever." It has been considered justifiable to regard all the different cases as typhoid, for the reason that this is the principal continued fever recognized by medical writers in this part of the country. It is possible that some of those cases reported as "fever" may be of local origin, like lung fever or brain fever; but the probabilities are against this. At any rate there is no more reason to doubt these statistics than those in regard to other affections. The whole number of deaths in the ten years is 263; a percentage to the total mortality of 4.6, and to the zymotics of 17.6. The mean rate per thousand of the population is 0.941. This mean rate is higher than the maximum of Boston since 1851.* It is at least one-third greater than the average rate

* See Report on Sanitary Condition of Boston, p. 105.

of Boston. But the disease is less prevalent here than in the purely rural communities.* It is, however, constantly present with us, and is nearly twenty-fold more destructive to life than the much-dreaded small-pox. It is also better understood in regard to its causes and means of prevention, than are some others of the zymotics. It is eminently preventable by sanitary measures. Two points are now admitted by many of the best authorities in respect to its etiology. 1st. That it is due to a specific poison, which can produce this disease and no other. 2d. That this poison is conveyed into the system by means of polluted air, water or food.

Filth alone, in the opinion of the writer, is not sufficient to cause the disease, but furnishes the conditions for its development and spread. In this place it appears to originate most frequently in contaminated well-water; and it is only necessary to recall what has been said in regard to the subsoil of Lynn and the character of its wells to understand why the disease is exceptionally prevalent.

In order to furnish evidence of a conclusive nature, a large number of cases have been investigated by myself and my assistant in this work, Dr. S. W. Clark. The facts adduced seem to support the theory given above.

Out of the fifty-three cases investigated, in forty-two of them the patients had habitually used well-water. The water of the wells from which eighteen of this forty-two drew their supply was proved by chemical examination to be badly contaminated by drainage from privies. In one other case the water was examined and shown to be slightly contaminated. Of the remaining twenty-three using well-water, in the case of eleven the wells were so badly situated as to excite suspicions of contamination. No chemical examination was made.

Out of the eleven persons who did not use well-water, five were shown to be exposed to emanations from cesspools or drains. In only six of the fifty-three cases were the hygienic conditions free from serious defects. In many of the cases a variety of circumstances tending to the production of this and other diseases was observed.

Typhoid has diminished in frequency since the introduction of pond-water, and the decrease is more especially noted in

* See Paper by Dr. Derby in Second Annual Report, State Board of Health.

the thickly settled parts of the city, the probable reason for this being that there the pond-water is more generally used in preference to the wells, than in the outskirts.

Scarlatina.—This terrible scourge of childhood ranks third among the death-producing zymotics in Lynn. Like typhoid fever, it is so constantly present with us, that it may be considered endemic. Yet it varies greatly in the degree of its prevalence at different times and seasons. It has caused, during ten years, 204 deaths, an annual average of 20.4. Its maximum mortality was reached in 1875, when it numbered 55 victims. The next highest mortality was in 1874 (32 deaths), and the minimum in 1866 (5 deaths). Its average percentage to the whole number of deaths is 3.6; to the zymotics 13.6. Mean number per thousand of population, 0.73. An examination of the map will show that it is more fatal, if not more prevalent, in the unhealthy sections of the city. In its distribution it seems to follow the same law as other diseases, and to seek places where its presence is not needed to fill up the measure of mortality, thus verifying the Scripture adage, "To him that hath shall be given." But the healthiest section, and the most carefully managed households are not exempt from its visitations and its ravages. There are no restrictive regulations in force in regard to it. Children from families affected are allowed to attend school, and no measures of disinfection are required after recovery. Were a strict system of registration, isolation, and purification adopted, there is little doubt that the disease might be much diminished in frequency, if not virtually stamped out.*

Diphtheria and Croup.—These diseases are reckoned together, not as implying that they are identical, but on account of the very general confusion of diagnosis. It is unquestionable that diphtheria does sometimes make its first appearance in the larynx, producing a case of diphtheritic laryngitis, which, in its symptoms, course and termination cannot be distinguished from membranous croup, if that be a separate disease; and on the other hand, when ordinary diphtheria causes great obstruction in the pharynx, the difficult breathing may

* Since this was written, I have learned that the school committee have passed an order forbidding children from families affected with scarlatina, small-pox, diphtheria, etc., to attend school. It may be reasonably doubted whether this order will be carried out.

lead physicians and attendants to speak of the case as one of croup. Hence no attempt is made to separate the diseases in the statistical inquiry.

From 1866 to 1875, they have caused 152 deaths, or 2.7 per cent. of the mortality. The percentage to the zymotics is 10.2. Mean number per thousand of the population, 0.544.

But the period embraced in this inquiry is sandwiched in between two epidemics of diphtheria, the one reaching its climax in 1865, and the other being now in progress. For this reason our rates appear lower than they would if a larger number of years were included. The present epidemic began in 1875, but did not become very general until last spring. Since then, however, it has occasioned such a large amount of mortality, that its treatment is reserved for a separate paper.*

Whooping-cough.—Whooping-cough comes next on the list, but it is "next by a long interval." Only 62 deaths are attributed to it in ten years. This is a percentage of 1.1 of all deaths. It is greater than the average percentage of Boston, but much less than that of England. It is the opinion among our medical men that whooping-cough is rarely or never fatal with us, except through complications, the most frequent of which are catarrhal pneumonia and acute hydrocephalus. The former comes on as the result of exposure, and the latter occurs chiefly in tuberculous children. In either case the death is but seldom ascribed to whooping-cough when the report is made by a physician.

Cerebro-Spinal Meningitis.—This, which is known in our community as the "new disease," does not appear in the records of mortality until 1872, when it stands credited with one death. In the year following, 32 were ascribed to it, and in 1874, 11. These compose the total number, 44. But there is no good reason to suppose that it has never occurred previously. With the prevailing ignorance and carelessness in regard to both diagnosis and registration, it would not be at all strange if some cases of death from this cause got into the records under the heads of "convulsions," "disease of the spine," or "disease of the brain." So far as the disease has been observed here, its most common habitat is the badly drained and otherwise unhealthy quarters of the city.

* This appears at a later page under "Health of Towns."

Erysipelas.—This disease is prevalent at times, but it cannot be said to be very fatal. Twenty-nine deaths have been ascribed to it in ten years.

Rheumatism.—In its various forms, acute and chronic rheumatism is very frequently met with in Lynn. It stands charged with 26 deaths in ten years, chiefly caused by rheumatic fever. It is probable that, indirectly, it is the occasion of many more deaths through the production of valvular disease of the heart. These, however, appear usually under the name of "heart disease."

Measles.—This affection is widely prevalent, but seldom fatal. Indeed, it seems to be uniformly of a mild type. It is possible, however, that some cases of death from pneumonia, which occasionally occurs as a fatal complication of measles, should be ascribed to it instead of the former affection.

Small-pox.—Small-pox cannot be charged with a large share of our mortality. It has occasioned only 15 deaths in ten years, a percentage of 0.026 to the whole number. During the time of its great prevalence in Boston, it occurred here in repeated instances, but did not assume a very fatal form. The city authorities have always taken wise and efficient measures to limit its spread. Had the course here pursued been followed by all other cities and towns in the Commonwealth, there would have been a great saving of life.

Alcoholism is widely prevalent; but as it is not popular to die a drunkard, its victims are hardly ever credited to it, unless they are poor and friendless.

Influenza, or catarrhal fever, is extremely frequent at certain seasons, and when an epidemic influence is abroad. It is rarely fatal. Five deaths are ascribed to it in ten years.

Syphilis is another zymotic of which it is not considered creditable to die. For this reason it seldom appears in the records as a cause of death. It is not as prevalent here as in larger cities; but unquestionably produces a vastly greater amount of mortality than is shown by the records.

Malaria.—Four deaths in the ten years are ascribed to malaria. The cases are mostly imported. The writer has, however, known of one that appeared to be genuine intermittent originating on the low, wet land close by Bog Meadow. It was cured promptly by quinine.

Purpura is charged with four deaths in ten years; carbuncle, tape-worm and malignant pustule with one each.

The percentage of the mortality caused by the constitutional diseases is divided as follows between the two orders of that class: diathetic, 10.9; tubercular, 16.6. Only one of the special diseases embraced in these orders is of sufficient importance in connection with our subject to require extended notice.*

Pulmonary Consumption.—This stands at the head of death-producing causes in Lynn, as in the country at large. It has produced 1,098 deaths in ten years; upwards of 19 per cent. of the deaths from specified causes. In early times consumption was not a frequent disease here, if we may credit Lewis, the historian of Lynn. He says (p. 81, History) that "formerly a death by this disease was a rare occurrence, and then the individual was ill for many years, and the subjects were usually aged persons. In 1727, when a young man died of consumption at the age of nineteen, it was noted as a remarkable circumstance; but now young people frequently die of that disease after an illness of a few months."†

There was no public record of deaths that had any claim to completeness until the year 1844. The church or parish records are available; but it is doubtful if they are fully reliable, even in respect to the members of the parish. Lewis says that "of 316 persons whose deaths were noticed in the First Parish for about 20 years previous to 1824, 112 were the subjects of consumption; and in some years since then, more than half the deaths have been caused by that insidious malady." This certainly shows a much greater percentage of mortality than has existed now for a long time. The phthisis-rate has been decreasing for some years, as is shown by the following table:—

* As it is impossible to consider separately all of the long list of special diseases belonging to this and the following classes, a selection is made of those which are relatively most prevalent in Lynn.

† The "History of Lynn" was first published in 1844.

Deaths from Consumption for Five Census Years.

Y E A R .	Percentage of Total Mortality.	Number per 1,000 of Population.	Y E A R .	Percentage of Total Mortality.	Number per 1,000 of Population.
1855, . . .	25.3	5.28	1875, . . .	18.2	3.58
1860, . . .	25.9	4.61			
1865, . . .	22.2	4.96			
1870, . . .	19.9	3.43	Mean, . . .	22.5	4.37

The averages for ten years (1866 to 1875) are a little less than those given above, but higher than those of the State. The decrease here observed may be partially owing to the greater degree of discrimination used in reporting cases. It is a well-known fact that the term "consumption" is employed as a convenient euphemism for alcoholism, syphilis, and similar disorders, and as a refuge from the charge of ignorance in obscure cases of internal disease. I think there is good reason to doubt if genuine phthisis were ever as prevalent as the earlier statistics would seem to show. In comparison with other cities and towns of Massachusetts, Lynn ranks among those having the greatest amount of consumption. In the Registration Report of Massachusetts for 1866 is a comparison of the 333 towns and cities then existing in the State, in respect to the prevalence of phthisis, based on the returns of the ten previous years. In this, Lynn is No. 308; the town having the most (Randolph) being No. 333.

The causes of the undue prevalence of consumption in Lynn must be looked for in the abundance of our wet and undrained lands, in neglect of ventilation, and that carelessness in the mode of living which is particularly characteristic of a certain portion of the population. But little influence, in my opinion, can be attributed to the east winds, or the moist air of the sea. As to severity of climate, Lynn only suffers in common with New England. An inspection of the mortality map will show that the black dots, representing deaths from consumption, are most numerous where the land is low, the clay near the surface, the sanitary condition in general defective, and the people largely of immediate foreign descent. These conditions frequently coexist.

Acute Diseases of the Lungs.—These alone, of the class of local diseases, require separate mention. They are included under the names of pneumonia, bronchitis, inflammation of the lungs, congestion of the lungs, lung fever, pleurisy, and "disease of the lungs." Sixty-nine cases were reported as "disease of the lungs" in ten years. Fifty-nine of these occurred in 1868 and 1869, only four deaths being ascribed to pneumonia during that time. As these are the only years in which the latter disease is credited with so few deaths, it is thought probable that those resulting from it were included in the deaths from "disease of the lungs." The whole group have caused 383 deaths in the ten years; 6.8 per cent. of the total mortality. Only consumption and the group of diarrhoeal diseases can claim a greater number of victims.

Pneumonia is not very frequent, but its relative mortality is high. Bronchitis is extremely common, but rarely fatal except with old people and children; and then the death is often ascribed to something else.

In regard to those diseases which rarely prove fatal, Lynn does not differ sufficiently from other places in the Commonwealth to render any extended remarks necessary. Briefly, however, it may be stated that mild catarrhal affections of the various portions of the respiratory mucous membrane are exceedingly common. Frequently recurring acute attacks of these disorders lead to the chronic form; so that one often meets persons who are never free from the necessity of blowing the nose, hawking to clear the throat, or coughing. The great prevalence of nasal catarrh here, as elsewhere in New England, may, I think, be looked upon as a cause of the habit of "talking through the nose," so called, which is regarded as characteristic of the Yankee race. Children acquire the habit often through unconscious imitation of their elders. The cause of these diseases is usually referred to the climate; but this certainly finds efficient allies in irregularly heated shops and dwellings, in lack of ventilation, and in all those conditions that lead to impaired vitality.

Another prevalent non-fatal disease is dyspepsia. In its

protean forms it affects a large proportion of our population, male and female. The form most commonly met with is the one which goes by the name of "biliousness." The cause is to be found, partially at least, in the undue rush and hurry of our busy seasons. The manufacturer has large orders to fill, and urges on his men; the latter wish to earn as much as possible to make up for the loss during the season of idleness. The hurry extends, even to eating and sleeping, all classes of the people being somewhat affected with the same spirit by contagion; and so the mischief is done which outlasts its cause.

Non-malignant affections of the uterus may also be mentioned in this connection. They are especially prevalent among those females who work in shops. While one cause of such troubles has been removed in the substitution of steam for foot-power in running sewing-machines, yet there are still a great variety of circumstances which tend to produce them. It is hardly possible for a woman to become debilitated from overwork, and continue so for any great length of time, without experiencing a certain amount of disturbance of the menstrual function. Neglected, as such disorders usually are, the functional derangement becomes organic disease, and perhaps a life-long source of suffering.

VI.—HEALTH OF DIFFERENT DISTRICTS AND STREETS.

If we were to judge by the general death-rate alone, it might seem that Lynn already possessed a degree of healthfulness accorded to few cities of its size, rendering any measures of sanitary reform unnecessary; and this, notwithstanding the fact that in our inspection of the city, we found many conditions tending directly to the production of disease. But it must be remembered that the general rate is an average, simply, and that it may be a mean between two wide extremes. By an examination of what follows, it will be seen that there are in our city, districts and streets which present rates of mortality equal to those of the most crowded cities, lying side by side with other districts and streets which rival the most favorably situated country town in healthfulness. That this could be the case without local causes oper-

ating to produce the difference observed, will hardly be believed by any one. If it be possible to determine with precision these local causes, the work of removing whatever is prejudicial to health will be materially aided.

The difference in mortality referred to has been set forth in two methods ; first, by means of the map which accompanies this Report ; secondly, by means of mortuary statistics. The map in a measure explains itself. Upon its surface are represented the deaths from consumption, cholera infantum, pneumonia, typhoid fever, scarlatina, diphtheria and croup, occurring in the city for ten years from 1866 to 1875 inclusive. It must be acknowledged that, owing to imperfection of the records, a portion of these deaths could not be located with sufficient accuracy to warrant their being put down ; and that some are, undoubtedly, at a little distance on the street from the exact spot of their occurrence. But these defects do not impair the value of the map for its purpose, which is to present an illustration to the eye of the relative amount of mortality occurring in different sections of the city. In forming an estimate of this amount from the map, it is necessary to take the density of the population, shown approximately by the tinting of the surface, into the account. The height of the land above low water and the depth of the clay from the surface being also indicated, it is interesting to observe the distribution of deaths with reference to these points. The fact can hardly fail to be noted, that in several places where the death-spots are aggregated with unusual closeness, the clay is near the surface. The grouping of spots in sections naturally wet was more manifest in the earlier years of the period. Latterly these natural defects have in some places been removed by drainage, and the death-rate in consequence lowered.

The conclusions to be drawn from a careful inspection of this map are amply sustained by the statistics derived from a study of the death-records. By means of these statistics and of the special enumeration of the population by streets, it has been possible to calculate the death-rates of the streets, and also to divide the city into health districts. In performing the latter task, it has been necessary to avoid, as much as

possible, the division of streets on account of the added difficulty of distributing the deaths. For this reason, the lines do not always follow the courses that would be desirable, and the difference between the districts is less marked than it would otherwise be. In going through the records, it was found that some of the deaths did not properly belong to Lynn; in others, no residence was given, and no amount of searching in directories or undertakers' books (the ultimate resort) would suffice to reveal it. These had to be omitted, so that out of 3,705 deaths, exclusive of still-births registered from 1870 to 1875 inclusive (the period covered by the investigation), only 3,592 could be located. This number is, however, obviously sufficient for the purpose. The omitted deaths are largely among those of foreign parentage; therefore the result of their omission is to diminish the death-rate of those districts which have the greatest foreign population. It will be remembered that the spots on the map show only deaths from consumption, pneumonia, and certain of the principal zymotics; while the statistics include all deaths, so far as it was possible to locate them. An exact correspondence, therefore, between these figures and the indications of the map will not be looked for.

Health Districts.—The city is divided into eleven districts, differing somewhat notably in healthfulness. The following table sets forth the population of the districts in 1875, the percentage of foreigners, the general death-rate, and special rates for consumption, diarrhoeal diseases, acute diseases of the lungs, and four zymotics, averaged for six years.

Districts I., II., III. and IV., having a population of 8,519, present an average death-rate of 24.4, nearly the same as that of Boston. On the other hand, Districts VIII., IX., X. and XI., with a population of 10,263, have a death-rate of 16.6, somewhat lower than the so-called "normal." The average of the other three districts combined is a little below that of the city as a whole.

Table of Health Districts.

HEALTH DISTRICTS.		Population, 1875.	Percentage of Foreigners and their children to whole population.	DEATH-RATE: Mean of Six Years (1870 to 1875, inclusive), Still-births excluded.				
No.	Name.			General.	Phthisis.	Diarrhoeal.	Acute Disease of Lungs.	Typhoid, Scarlatina, Diphtheria and Croup.
I. ¹	Waterhill, . .	2,533	59.5	25.4	4.9	3.6	1.4	3.0
II. ²	Harbor, . . .	3,449	63.7	25.1	4.3	3.4	2.3	3.5
III. ³	Western, . . .	1,892	30.0	22.1	4.2	2.8	1.7	2.8
IV. ⁴	Wyoma, . . .	645	5.6	22.1	2.8	2.2	1.4	4.4
V. ⁵	Central, . . .	5,999	21.4	19.6	3.5	1.9	1.6	2.1
VI. ⁶	Eastern, . . .	4,633	23.4	18.5	3.7	2.1	1.6	1.8
VII. ⁷	Franklin, . . .	3,185	14.6	18.4	4.0	1.9	1.3	2.1
VIII. ⁸	Glenmere, . . .	1,685	12.4	17.3	2.7	2.4	1.4	1.4
IX. ⁹	Common, . . .	4,343	15.5	17.1	3.2	2.1	0.9	1.2
X. ¹⁰	Highland, . . .	1,972	37.1	16.0	3.0	3.1	1.4	1.7
XI. ¹¹	Ocean, . . .	2,264	8.1	15.5	2.3	1.6	1.2	1.7
	City, . . .	32,600	28.5	19.5*	3.6	2.4	1.5	2.1

* Only those deaths which have been distributed among the different districts have been used in determining these general rates. The rates are all based upon a carefully estimated mean of the population for the six years.

- ¹ District low-lying. Soil generally damp. No artificial drainage. Strawberry brook, polluted by drainage from morocco factories, flows through it. In many streets the sanitary condition of dwellings is bad.
- ² Borders the harbor, which is foul from sewage. The glue factory and polluted creek before described are within its limits. Many dwellings in bad condition. Clay near surface. Sewers.
- ³ Sparsely populated. Much of soil wet. No artificial drainage. Clay on low lands near surface. Dwellings variable, good and poor.
- ⁴ High and dry. Many people of poorer class. Sanitary condition of many dwellings defective.
- ⁵ Generally well drained. A few places damp. Many boarding-houses. Many adults and few children. Sewers.
- ⁶ A portion of the land wet. No artificial drainage, save partially for surface. Sanitary condition of dwellings variable, good and bad.
- ⁷ District well-conditioned, as a rule. Soil naturally damp. Formerly marshes. Drainage by sewers.
- ⁸ District with all characteristics of a country village. Soil dry, save round Bog Meadow. No artificial drainage.
- ⁹ Sanitary condition of dwellings mostly good. Soil dry, except near marsh. One or two sewers. Clay deep.
- ¹⁰ Sanitary condition of dwellings good, with some exceptions. High and dry. Natural drainage excellent. No sewers.
- ¹¹ Sanitary condition of dwellings good. Soil dry. A few sewers. No clay has been found.

NOTE.—The word “good,” as used in these notes, does not imply the ideal perfection of the sanitarian, but is simply comparative.

Some of the facts set forth in this table require special comment:—

1. The two districts having the highest death-rates are those containing the largest percentage of foreigners. Yet the Highland District, which comes third on the list in its relative number of foreigners, ranks next to the Ocean District in healthfulness. This must be attributed, in a measure, at least, to the location. The death-rate among the foreigners living in the Highlands is but 17.8 per thousand; while that in the Waterhill District is 27.5. Among the natives on the Highlands the death-rate is 15.1 per thousand. Among the same class in the Waterhill District, it is 22.1. The difference in the phthisis rates of these two districts is a matter of interest, in connection with the character of the soil.

2. Wyoma District is one of those having a high death-rate; yet it contains the lowest percentage of foreigners. Its phthisis-rate is remarkably low; but that from the four prevalent zymotics is very high. The high death-rate of this region must be accounted for by the mode of life of a portion of its inhabitants.

3. Contrary to what might be expected, the mortality from diarrhœal diseases is quite low in the crowded Central District. This is perhaps due to the great number of adults living there in proportion to the number of children.

4. The Franklin District is an average one for healthfulness. But while its death-rates from diarrhœal and acute lung diseases are low, that from phthisis is exceptionally high. In this connection, what has been said of the natural drainage of the region, and the general character of the soil, may be recalled.

5. The low rates from phthisis, and the three groups of diseases in the Ocean District, which has a dry soil *and is otherwise well conditioned*, are matter for observation.

I give next a table showing the death-rates of some of the representative streets of the different districts, all but a few of which have a population of more than 140. The very long streets, and those which differ notably in the different parts, like Beach, Sagamore, Broad, Fayette, and others, are not given, for the reason that the death-rate, which is but a mean of the sections, does not fairly exhibit the sanitary condition of any of them. Other facts of interest in this connection are also set forth.

Streets with a Death-rate of more than 31. Very High.

NAME OF STREET.	POPULATION, 1875.		Death-rate, mean of Six Years, 1870 to 1875, Inc.	DISTRICT.	Height of Street above tide-water, feet. (Grounds omitted.)	Nearest Whole No. of 17 footman in each 100 ft. in length of Street.	Sewerage.	Natural Drainage.
	Natives.	Foreign.						
Murray, ¹	28	104	31.5	Waterhill,	16,	16	None,	Defective.
Harbor, ¹	36	207	31.5	Harbor,	4 to 8,	15	Sewer in 1872, 300 ft.,	" surface-drainage good.
North Federal, ¹	36	115	33.4	Waterhill,	13 to 27,	17	None,	Underdrainage defective.
Lynnfield, ²	117	8	35.8	Wyoma,	63,	4	"	Good.
Amity, ¹	37	158	37.5	Harbor,	5 to 35,	32	Sewer in 1871,	Mostly good.
Pleasant, ¹	149	220	39.7	"	4 to 23,	17	Sewer in 1870,	Defective.
Waterhill, ¹	39	236	42.8	Waterhill,	12 to 20,	14	No sewerage,	Fair.
Allen's Court, ¹	13	83	52.4	Eastern,	45 and less,	11	"	Good.
Fayette Court, ¹								
Orange Court, ¹								

* These courts are continuous, and virtually make one street. See map.

Immigrants mostly Irish. Numerous hygienic defects observable in dwellings.

* Numerous hygienic defects observable in dwellings.

[NOTE.—The death-rates of streets, being based upon fewer data, are more variable as indications of sanitary condition than those which apply to larger numbers of people. When a sufficient number of years, however, are covered by the investigation, this difference, in a measure, disappears.]

Streets with a Death-rate of 22 to 28. High.

NAME OF STREET.	POPULATION, 1875.		Death-rate, mean of Six Years, 1870 to 1875, Inc.	District.	Height of Street above tide-water, feet. Fractions omitted.	Nearest Whole No. of Inhabitants to each 100 ft. in length of Street.	Sewerage.	Natural Drainage.
	Natives.	Foreign.						
May, ¹	37	147	22.4	Waterhill, . .	14 to 18,	19	No sewerage, . .	Defective.
South Common, ²	137	28	22.7	Common, . .	21 to 26,	6	Partial sewer, 1869, . .	Good; loose subsoil.
Grove, ³	144	2	23.3	Waterhill, . .	20 to 40,	8	None,	Good and poor.
Shepard, ³	308	69	24.3	Common, . .	5 to 22,	16	Sewer in 1868,	"
Maple, ⁴	326	28	25.	Glenmere, . .	44 to 74,	7	None,	Good.
Rockaway, ⁵	184	122	25.1	Highland, . .	46 to 124,	21	"	Surface-drainage good; springy.
West Charles, ⁶	148	38	25.3	Common, . .	3 to 7,	25	"	Defective.
Jackson, ⁷	147	20	25.6	Eastern, . .	37,	8	"	Old part good; new, defective.
Smith, ⁷	141	35	27.4	Central, . .	35 to 38,	29	"	Good.
Nelson, ⁸	52	90	27.7	Waterhill, . .	9 to 15,	21	"	Defective.
Franklin, ⁹	364	73	27.8	Franklin, . .	27 to 34,	17	Sewer in 1870, 924 feet, . .	Defective water-table 4 feet from surface in summer.

Streets with a Death-rate of 17 to 22. Average.

Whiting, ³	138	12	17.	Franklin, . .	22 to 26,	13	Sewer in 1868, . .	Defective.
Ocean, ¹⁰	142	24	17.2	Ocean, . .	29 to 45,	5	None,	Good.
North Common, ³	177	58	17.4	Common, . .	21 to 24,	9	350 feet sewer, 1874, . .	"
Green, ³	247	15	18.4	Central, . .	36 to 49,	15	None,	"
Adams, ¹¹	29	121	19.	Highland, . .	112,	16	"	"
Park, ³	121	17	20.8	Franklin, . .	24 to 27,	9	Partial sewer, 1874, . .	Mostly good.
Howard, ¹³	119	44	21.1	Central, . .	42 to 48,	17	None,	Good.
Myrtle, ⁹	88	52	21.7	Western, . .	7 to 20,	7	"	Defective.
Liberty, ¹³	78	78	21.7	Central, . .	16 to 52,	10	Sewer, 1873, . .	Part good, part defective.

Streets with a Death-rate of 13 to 17. Low.

Sachem, ¹⁴	111	23	13.3	Ocean,	.	.	.	21	None,	.	Good.
Neptune, ⁸	220	57	13.7	Common,	.	.	.	18	"	.	Good in part, part defective.
Mail, ¹⁴	49	12	14.7	"	.	.	.	6	"	.	Good.
Brookline (and Court), ⁷	71	79	16.4	Eastern,	.	.	.	10	"	.	Inhabited part good.
Newhall, ¹⁶	210	20	15.6	Ocean,	.	.	.	13	257 feet sewer in 1876,	.	Good.
Cottage, ¹²	91	140	15.5	Waterhill,	.	.	.	10	None,	.	Mostly good.
Baltimore, ¹⁴	114	14	15.6	Ocean,	.	.	.	10	Sewer in 1876,	.	Good.
Nabask, ¹⁴	186	34	16.2	"	.	.	.	11	None,	.	"
Union, ¹⁸	568	242	16.7	Central,	.	.	.	23	Sewer, 1866, '67, '68, and 1873,	.	Variable. Good and bad.

Streets with a Death-rate less than 13. Very Low.

169	31	7-2	Common,	-	6 to 26,	9	None,	Loose subsoil; mostly good.
26	96	7-2	Highland,	-	112 to 132,	37	"	Good.
159	13	8-3	Common,	-	7 to 14,	16	"	Loose subsoil; mostly good.
86	19	9-2	Central,	-	42 to 64,	16	"	Good.
37	2	9-7	Ocean,	-	42 to 48,	9	"	"
122	14	10-4	Franklin,	-	34 to 41,	13	"	Surface-drainage def.
93	20	11	Ocean,	-	42 to 45,	15	"	Good.
192	46	11-2	Central,	-	31 to 38,	23	"	"
181	12	11-2	Common,	-	17 to 24,	12	"	Loose subsoil; mostly good.
246	28	11-9	Franklin,	-	20 to 28,	17	Stone drain,	Bather poor.
97	19	12-4	Ocean,	-	41 to 51,	13	"	Good.
132	26	12-4	Highland,	-	40 to 111,	10	None,	"
174	29	12-8	Glenmere,	-	51 to 56,	11	"	"

1. Foreigners mostly Irish. Numerous hygienic defects observable in dwellings.

Some of the dwellings are old, and apparently in poor condition.

Dwellings appear in good condition.

4. **Summe defektive dwelling.**

Foreigners mostly Irish. Apparently good houses.

Many colored people.

Dwelling average.

■ **Foreigners mostly Irish.**

- Many poor dwellings, some poor.
- Foreign money Irish.

Many poor dwellings, some poor. Many wealthy people. Dwellings mostly good.

Foreigners mostly Irish. Some dwellings defective.

Foreigners mostly live in leased dwellings. Some are leased by the state, some are put out for rent by private individuals. Some are owned by foreigners and leased to others.

19 Dwellings mostly good: a few poor.

u4 Dwellings good.

16 The street has a good appearance.

All the districts contain some streets that exhibit a high death-rate, and others which exhibit a low one. It is the predominance of one or the other of the classes which gives the character to the district. The highest rates are shown in connection with water polluted by drainage. Witness the three courts on the borders of Silver Lake; Waterhill Street, which runs along the lower course of Strawberry Brook; and Pleasant Street, near the polluted harbor and creek. In all of these places, however, there are prominent hygienic defects in the construction and management of many of the dwellings. Privies are unclean, piggeries abound, and intemperance is not rarely observed among the inhabitants.

Although foreigners predominate in many of the most unhealthy streets, it is measurably certain that this fact alone cannot explain their unhealthiness; for we find, on the one hand, certain streets, as Lynnfield and Bacheller, the inhabitants of which are nearly all natives with a high death-rate; and, on the other hand, certain streets, as Acorn and Cottage, with a low death-rate, the inhabitants being largely of foreign parentage. Nor can the height of the land above the level of the sea furnish the full solution of the problem; for some of these streets having a low rate of mortality are on the borders of the marsh, although possessing a comparatively dry soil. Our investigations have furnished no evidence that residence near a clean salt-marsh, on land which is itself well drained, is very unhealthy. The case is far otherwise, however, when the marsh is polluted by sewage.

A careful survey of all the facts adduced has convinced the writer, that in a contamination of water, soil, and air by accumulated filth,—in intemperance, careless habits of living, and general neglect of sanitary laws (influences which, when operative, affect natives and foreigners alike), combined in not a few instances with natural unhealthiness of site, must be found the explanation of the great variation in mortality between the different streets and districts of the city. If foreigners suffer more than natives, it is not because of any predisposition to disease, of any constitutional weakness of the races, or difficulty in becoming acclimatized, but because they are more exposed to the operation of the causes above mentioned.



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VII.—CONCLUDING REMARKS.

Notwithstanding the fact that the general death-rate of the city is, on the average, not very high, there is an urgent and immediate necessity for sanitary work. That this is the case, and that the necessity applies to the city as a whole, will be apparent from the following considerations :—

1. In certain streets and sections of the city there exist many removable causes of disease, and as a consequence a large excess of mortality.

2. The healthy portions suffer, in a measure, with the unhealthy. Infectious diseases, which find a permanent abiding-place amidst the filthy privies, sink-holes, and pigsties of the latter, spread at times into the former, no amount of cleanliness and care forming an effectual barrier to their entrance. Hence it is that families which conform the most nearly of any in the community to the laws of health, are sometimes destructively invaded by scarlatina, diphtheria, typhoid fever, and similar diseases.

3. Serious sanitary defects, themselves the immediate cause of disease, are not unfrequently found lurking under the fair exterior of our best houses. The death-rate of the healthiest and best-conditioned districts is thus rendered greater than it should be.

4. The aggregate loss from sickness and death may be said to fall upon the community sustaining it as a whole. It certainly lessens production, increases pauperism, and in various other ways checks material growth. It is not necessary to enter upon any labored calculations, as some have done, to obtain the exact measure of this loss in dollars and cents. Suffice it to say, that it forms a vastly greater burden for the shoulders of our people than the taxation of which they so much complain. An organized and determined effort to diminish this loss would be evidence of wisdom.

It is now proposed to state briefly what are conceived to be the most pressing sanitary needs of the city, so far as they come within the province of public hygiene. This is partly for the sake of bringing in certain general suggestions as to

the remedial measures to be employed, and partly by way of recapitulation.

1. *More Attention to Soil-drainage.*—An illustration of the good that might be accomplished by the city in this direction, is furnished by the case of Bog Meadow. The map shows how readily, by deepening the channel of Stacey's Brook, and the construction of lateral tile or stone drains, this bog might be deprived of superfluous moisture. Were it done, an area of waste marsh-land would be converted into a productive garden; and the residents on its borders and along the course of Stacey's Brook could underdrain their wet lands with the greatest ease, thus removing one of the causes of phthisis, and possibly of other diseases. Similar results might be attained in other parts of the city.

2. *An Improvement in the public Water-supply.*—The amount stored should be increased, so as to allow of that natural purification which results from long standing. If the water were thus rendered clear and colorless, the change would probably lead to its universal use, and an abandonment of the wells, which experience has shown so liable to contamination. As an aid to this purifying process, the storage-basins ought, perhaps, to be thoroughly cleansed of all decaying organic matter. It is not pretended that the color now possessed by the water indicates anything harmful in its constitution, but it is, on this account, unacceptable to great numbers of the people; and it will remain so until this seeming defect is remedied.

3. *A better System of Sewerage.*—The sewers are too few in number, and destitute of the means of ventilation. The disposal of the sewage is highly objectionable. Under this head may be mentioned the necessity which exists for preventing factories with an offensive sewage from discharging it on the surface of the ground, or into streams which never receive flushing.

4. *An improved Method of disposing of Night-Soil and the Contents of Cesspools.*—To accomplish this, it is necessary to substitute a better form of privy for the miserable affairs now in use. With the abundance of coal ashes everywhere to be obtained, there would be little difficulty in carrying

out the pail-closet system so successfully used in Rochdale, England.*

While cesspools are necessary, as they must be for long time to come, in many portions of the city, they should be made water-tight, and emptied in the most approved manner.

6. *A better System of removing Garbage.*—Almost any change from the present plan would be an improvement; but the work should be done in a specified manner, by contractors, under the direct supervision of the health authorities. This would be the means, in a measure at least, of abolishing piggeries, thus doing away with another form of nuisance.

7. *More Attention to the Subject of Ventilation.*—Although this is largely a matter for individual management, yet in the case of shops, school-houses, etc., the city has an obvious duty to perform.

8. *A more effectual Plan for limiting the Spread of certain Zymotic Diseases.*—There is no good reason why scarlatina, diphtheria, and other less prevalent diseases, should not be dealt with as carefully as small-pox. They are relatively as fatal. Scarlet fever caused, in 1875, nearly four times as many deaths as small-pox in ten years. Our experience of the terrible ravages of diphtheria is too recent to require any mention to be made of that. Epidemic dysentery has been very destructive to life in former years, and it may visit us again. People would soon become reconciled to the ideas of registration, isolation, and disinfection, when once convinced of the good to be accomplished by such measures.

But by far the most urgent need of Lynn at the present time is—

9. *The establishment of an Independent Board of Health,* clothed with authority to decide and act in regard to all the sanitary interests of the city. This would be in itself a possible remedy for all the evils that have been mentioned. By the report of the auditor for 1875, it appears that the expenditures of the board of health for the year were \$47.59. This for a city of 32,600 inhabitants, and losing hundreds of thousands of dollars every year by preventable sickness and death! It is idle to expect that under the plan now in operation any

* See paper by Dr. F. Winsor, in Seventh Annual Report of the State Board of Health of Massachusetts, p. 182 *et seq.*

abuses will be corrected, or improvements made. The members of the board of aldermen, who are intrusted with these important matters, are not selected on account of their qualifications as guardians of the public health ; and burdened as they are with legislative and other duties, it is hardly matter for reproach that they give little or no attention to that work which ought never to have been required of them.

REGISTRATION OF DEATHS AND OF DISEASES.

By CHARLES F. FOLSOM, M. D.,
SECRETARY OF THE BOARD.

REGISTRATION OF DEATHS AND OF DISEASES.

One of the leading sanitarians of the United States recently said, "No method has yet been found, or at least acted upon, whereby the actual death-rate can be positively ascertained for the United States, or, so far as I know, for any single State."*

It has seemed desirable to ascertain how we stand in reference to so sweeping a criticism, and the result of the inquiry has been that we can only say that we are a little better than some of our neighbors.

The first of the following series of questions was sent to the medical correspondents of the Board in October; and the second, a little later, to the clerks of the cities and towns throughout the State:—

I. Is the registration of deaths and causes of death complete and satisfactory in your town? If not, please suggest any deficiencies of which you are aware, whether *all* deaths are returned to the undertakers, whether the undertakers themselves return them promptly and accurately to the clerks, whether causes of death are reported by the physicians in all cases, etc., etc.?

II. Will you be kind enough to inform us whether the registration of deaths and causes of death is complete and satisfactory in your town? If not, please suggest any deficiencies of which you are aware, whether *all* deaths are returned to the undertakers, whether the undertakers themselves return them promptly and accurately to the clerks, in what proportion of cases the *causes of death* are reported by physicians, etc., etc.?

* Report on the Death-rate of each sex in Michigan, and a comparison with Dr. Farr's Life Tables of Healthy Districts in England. By Henry B. Baker, M. D., Secretary of the State Board of Health and Registrar of Vital Statistics of Michigan. 1876.

INFORMATION FROM PHYSICIANS.

One hundred and ninety-six physicians replied to our circulars. Of these, 44 reported that the registration is satisfactory, 118 reported that it is not satisfactory, and 34 replied so indefinitely that it was not possible to say from their returns whether the law is complied with or competent to meet all requirements, if obeyed, or not.

In regard to the registration of the full number of deaths, without regard to their causes, 54 have reason to think that this is fully done, 45 reply that it is not done, and 97 answer indefinitely; that is, they do not answer that particular question, they have no suggestions, they do not know, or the reply is so worded as not to convey a definite statement.

The very large number of "indefinite" answers as to the registration of the full number of deaths, may be explained on the ground that it is a question on which comparatively few have an opportunity of getting exact information.

Of course, it is not expected that absolutely "satisfactory" registration can be got in all cases. The word, therefore, in tabulating the returns, has been used to express as satisfactory a registration as we can expect with the present degree of human imperfection and until we have some system or law regulating the practice of medicine. For instance, the following two replies (10 and 26, p. 235,) were classed as "satisfactory." Strictly speaking, the first indicates a condition of things which is very far from "satisfactory"; and the importance of some legal restrictions upon irregular and incompetent physicians is great. In tabulating the returns, however, it was thought best to confine attention to those defects which were referred to in the circular sent out.

It would be very easy, however, to have a registration of physicians in our State, as has been done in Europe and in some of the cities of our own country, notably Brooklyn and New York. In such case, any person not possessing a diploma from some responsible medical college should be excluded from the privilege of signing any medical certificate involving responsibility.

A certain portion of the community will always prefer to consult "healing mediums," etc., and probably could not be

prevented from so doing by any law ; but it is of importance to the State that every death should be as faithfully and intelligently certified to as is possible, and the public should see to it that this is done in every case.

10. In this town, as in nearly every town in the Commonwealth, we have some irregular and incompetent practitioners of medicine, whose diagnoses would be of doubtful accuracy and not to be relied on for scientific conclusions. Yet the registration of deaths and causes of death is as complete and satisfactory in this town as in most towns probably.

26. The registration of deaths is apparently quite complete. The *cause* of death is not always correctly given, owing oftentimes to an impossibility of obtaining an autopsy. Probably the returns to the undertakers are as complete as they could be made by any legislation.

Nothing would be gained by quoting affirmative replies at length ; enough of the others are given to illustrate all the deficiencies in the present methods.

Our correspondents generally testify that the town clerks are ready to heartily coöperate in the work of good registration, and that, where there is any deficiency on their part, it is from following established custom or from inherent difficulties.

Replies of Medical Correspondents.

1. The registration of deaths in this town is quite complete and satisfactory, with perhaps the exception that the *cause of death* is reported in too general terms, a matter that can be easily remedied by physicians making the report, which is not done in all cases now. The deaths are returned by the undertaker to the clerk once a year ; this, perhaps, is not as often as it should be done, but such matters, I think, cannot be attended to conveniently with that promptness in country places as in cities.

2. I presume that our town authorities are not remiss in reporting all cases of death, but are certainly not over-particular in the minutiae of the subject,—in fact, have not in a single case referred to me for such particulars.

5. Undoubtedly the number of deaths is given the clerk with sufficient accuracy, but the causes of death in many cases must be quite imaginary, as the physicians are not consulted about this.

7. The cause of death is invariably returned on the undertaker's certificate and is given by the friends of the deceased. I am never asked to make out a physician's certificate.

9. In a few instances, decedents are taken to other places for burial without the town clerk's license [and probably escape registration].

17. I think all deaths are returned, but I think that the value of registration is essentially impaired by wrong causes being reported, usually through ignorance; there is evidently no intentional misrepresentation. Perhaps the physician's signature accompanies about two per cent. of all certificates.

18. It has been the custom for the undertaker to take around, *once or twice a year*, to physicians, their blanks, filled out in other respects, and get the attending physician to certify. If not disposed, they have filled them out themselves.

19. The registration of deaths and their causes in this town is very *incomplete and unsatisfactory*, and I am aware *all* the deaths are not recorded. The custom has been for the town clerk to go through the town once a year and "collect the births and deaths"—while during the year many births and deaths have occurred in families who have removed from town; consequently no record can be made of them. There being no particular undertaker, I think no one ever makes any return to the clerk, and I think the cause of death is never reported by any of our physicians. I have long been aware of the unsatisfactory manner and incompleteness of the registration of deaths and causes of death, not only in this town, but in many other towns.

24. Since I received your circular I have had an interview with the town clerk. He says the registration is all a farce. I inquired how he procured his information, and he said it was supposed he would send to every house, but I think he takes the neighborhood reports.

24½. The undertaker usually puts down the *cause* from hearsay oftener than he ascertains from the attending physician the real cause.

25. I think the registration of deaths is generally made quite promptly, but the undertakers are not careful enough to inquire of the physicians as to the causes of death, and one often sees names given which are altogether outside of medical nomenclature. The physicians are equally careless in the same thing, and one would often be in doubt to know what the true cause of death was, unless they had attended the cases themselves, as our yearly death-list will testify. The law does not oblige a physician to give the cause, unless applied to for it, and then he is liable to a fine of ten dollars if he does not make the return in fifteen days. I think an improvement can be made by obliging the physicians to fill blanks in a scientific manner and return them to the clerk without having the undertaker as a medium.

28. I would suggest as an amendment to the statutes on this subject, that no interment be allowed to take place, under a severe penalty, in any town or city, without the certificate of the clerk of the town or city in which the death occurred (or the deceased resided) *having been first obtained*. There seems to me to be no necessity for any exceptions.

34. In a full practice in this town for more than *forty-four years* I have never been asked for the causes of death, nor have I ever so reported. We do not have, in the country towns, "undertakers," and of course no returns of such persons have been made to clerks.

35. There are a considerable number of cases of death among the foreign population who die without any regular medical attendance. I have supposed they were reported by the sexton as *deaths*, but the *cause* of death would often be random *guessing* on the part of relatives.

36. I have never been called upon to give the causes of deaths, and therefore cannot say whether they are accurate or not.

37. The registration of deaths, and the causes of death, in this town, has been very imperfect; and, as far as sanitary purposes are concerned, worse than useless. Last year I made a formal protest to our selectmen, the registration was so incorrect, especially as to the *causes* of death, more than one-tenth being recorded incorrectly. The undertaker has been in the habit of asking the friends the "cause," and once in two or three months reporting to the town clerk. Of course such statistics are worse than useless. Statistics, to be of any value, should be themselves correct. This year I have been asked in a few cases to certify as to the cause of death; for several years past, not once. There ought to be a law compelling the sexton to require of the physician in charge to certify to the cause of every death, *before* interment, with a penalty attached for non-performance. No respectable physician would ever object to doing this. The law now is, I believe, that the physician shall give a certificate when required to do so; but no one is compelled to make the request. No body should be removed from town, or interred, without a proper certificate of the cause of death from the attending physician.

39. Many times the physician never sees the return at all. The statement of some member of the family is all the authority. I don't think, during my practice, that fifty per cent. of the deaths were returned in a proper manner.

43. The registration of deaths in our town is done after a poor fashion. Near the end of the year, or rather, near the time to make the annual returns, the town clerk himself, or some one for him, goes around and "picks up" all the deaths he or she can hear of; the cause of death is learned from friends or neighbors. I do not, nor does any other physician, make any returns to the clerk, in our town.

44. The registration of deaths here is not satisfactory. There is one undertaker, and he is negligent in this matter, frequently letting the half-filled blanks remain on his hands and accumulate till the end of the year, then getting the physicians to certify to the causes of death from memory, which in many cases involves inaccuracy. I do not know but all cases may be returned, but I do know, that by reason of the slack way in which it is attended to, there is much guesswork in the final report when it is made up.

47. Before burial in our cemeteries, it is of course necessary to secure a permit from the city authorities, and so far the registration is complete. Whatever return there is of the *cause* of death comes from the undertakers, and from them alone. I do not remember to have been asked the cause of death in more than two or three instances for many years. The undertakers prepare the statement from reports of friends. The city clerk informs me that there is much delay in the sending in of these reports, generally requiring his

personal attention to obtain them, and then not very satisfactory in every case.

48. I can unhesitatingly say that the registration of the *causes* of deaths is *anything* but satisfactory. I think there is no doubt but that all deaths are recorded.

49. The registration of deaths in this city is complete, in so far that the total number is correctly returned. It is not satisfactory, in that there is some confusion in the important item, "cause of death." It has been customary for the undertaker to fill up the blanks, generally without consultation with the attending physician, relying upon friends for his information. In cases which he considered doubtful, the physician is sometimes called upon for his opinion, and to fill the blank. In the cases in which the cause of death is given to the satisfaction of the undertaker by friends of the deceased, he inserts the name of the physician, though he has not seen the certificate. I have to-day examined the certificates returned to the clerk's office for a couple of months past, perhaps fifty in number. The name of the attending physician has been inserted in all, but in only two or three instances by himself.

50. The registration of deaths and causes of death is, I think, very unsatisfactory, so far as our city is concerned. I think, however, that but few deaths escape registration. So far as "causes of death" are concerned, the record is of comparatively little value. The undertakers almost never take the certificate of return to the physician who attended the deceased for his signature of cause of death, but put down as cause of death whatever the family say the doctor said was the cause. I got the returns of the last year from the city clerk to look through, to find out about some of these things I have mentioned. We have a yearly mortality of about two hundred or more at present. I think there were obtained, last year, three certificates of death with signatures of physicians, out of two hundred.

A case of "chronic rheumatism" was cirrhotic kidney; a case of "ulceration of the bowels" was cancer of rectum; a case of "heart-disease" was septicæmia or pyæmia, following amputation for old disease of knee-joint; a case of "tumor" was aneurism of the aorta. "Infancy" is down for twelve deaths, etc., etc.

I have been trying to do something to make our registration better, and the city clerk has seen the undertakers, and they agree to take their certificates of return to the physicians for their signatures. I brought up the subject in our local society, but I did not succeed in getting the members interested apparently; nobody, with one, perhaps two exceptions, seemed to care anything about it.

51. If the law provided that no burial could take place without the possession by the proper authority, of a certificate of the cause of death from the attending physician, it would seem that some of the faulty and unsatisfactory "causes of death" might be avoided.

55. As far as I can learn, both from my own experience and from inquiry of the clerk of the town, I think it (registration) has been done in an imperfect manner, and necessarily, from the fact that the returns have been made once a year.

56. So far as my experience and knowledge of registration of deaths extend, it is far from satisfactory; and this, I believe, is mainly due to neglect on the part of the undertakers in complying with the requirements of the law. Certificates of death are generally sent in some weeks and sometimes months after burial. I always attend immediately to the filling out of certificates on receiving them. I have now upon my desk two that have been there several weeks awaiting the call of the undertaker.

57. I am not called upon in half my cases to give the certificate. I understand that undertakers get them filled by the family, and I know that many certificates are wholly false as to cause of death. Almost any cough is reported either "consumption" or "lung fever," and so in other diseases.

61. The method of registration for this town is as follows: Two persons dig the graves and drive the hearses. These persons, at the end of the year, go about town and visit every house in which they learn of a death or birth having taken place during the year. The name, age, disease of which the person died, etc., are put down, and all are returned to the town clerk. The record is, therefore, made up wholly of the statements of the families in which the person died. Physicians make no return whatever. In a few instances, families, if uncertain of the causes of death, refer the sexton to the physician. More commonly they are better satisfied to give their own opinions than those of the physician, if they do not happen to coincide. Hence the record cannot be very accurate. In looking over the records for various purposes, I have been very much dissatisfied at what I found in many instances assigned as the cause of death in cases that I had treated.

66. The undertaker fills out the blanks relating to causes of death, according to the dictation of the family. When the disease is obscure or peculiar, the physician is consulted to give the name of the disease, but this is often loosely done. I am not able to report as to the promptness of returns to the city clerk.

67. So far as I can learn, all the deaths in this city are reported except *still-births*, of which I find no record. The city clerk informs me that the undertakers are generally prompt in their returns. Physicians do not make out certificates of the causes of death at all, that I can learn of, though on half a dozen returns rendered this year, I find the physician has filled out the cause-of-death blank (on the undertaker's return), and signed his name in the space left for the name of the attending physician. In 60 of this year's returns the name of the physician is given, but his signature is not attached. In 134 of this year's returns the name of the physician is omitted. The cause of death in many cases is obscurely or incorrectly given, as "weakness," "cut with a knife," "accidental," "inward spasm," "cold," "troubled in the brain," "dropsy," "debility," "teething," etc. One return has the honest record of "don't know," which indeed causes many deaths. I would suggest that it be required for the physician to fill out and sign, in every case, the cause-of-death blank on the undertaker's return before it is handed in to the clerk.

71. Causes of death are never, or rarely, reported by the physicians of this town. The clerk makes up his report upon hearsay testimony, never asking information of the physician in charge of the case. I have known "puer-

peral fever" returned as "typhoid," or, in another case, as "lung fever." So far as my observation extends, in this and many other country towns in Western Massachusetts, very little dependence can be placed upon the statistics of causes of deaths as returned by town clerks. Undertakers never require any certificate from attending physicians. I would suggest that it be made a penal offence for an interment to occur without the undertaker having a certificate from some respectable physician, and that a further penalty be added if the undertaker fails to return this certificate to the town clerk.

74. As I have been town clerk for the last twenty years, I can speak from personal observation, and, when I say that the death-returns are incomplete and unsatisfactory, I only say what I know to be the truth. In fact, in some forty deaths returned the past year, I did not find five certificates from physicians, notwithstanding I had been careful to furnish them with a full supply of blanks for the purpose. As a matter of course, the great object in view is, to a great extent, lost. The number of deaths is promptly returned according to an understanding with the sexton, and, if physicians would only meet the requirements of law, our returns would become reliable. The only remedy which suggests itself to me at this moment, is, that a certificate from the clerk to the sexton, that all the requirements of law had been complied with, should be furnished *previous* to burial, and that the sexton shall be *prohibited* from making burials without such certificate, under penalty. Some efficient remedy should be applied soon in order to render the returns valuable.

75. I think the registration of deaths in this city has improved since I referred to it in a communication to you a year or two since. I have taken occasion to urge upon the undertakers the importance of obtaining the written statement of physicians in relation to the causes of death. Formerly it was customary, and it is practised, I fear, to some extent now, for the undertakers to take the statement of the friends of the deceased in regard to the cause of death, without consulting the attending physician. Most of the undertakers, however, submit the proper blanks to the attending physicians to be filled by them. It often happens, particularly among the poorer classes, who are not able to employ, or do not choose to employ, a physician through the course of a disease, that a physician is called, perhaps once, to prescribe for a patient, and, after that, his services are not requested, and the patient, after the lapse of an indefinite period of time, one, two, or more weeks, dies. When the return is made out by the undertaker, he may apply to the physician for the nature of the disease, but it is often quite impossible for the physician to state accurately the immediate and sometimes even the remote cause of death. In consequence of the great diversity of skill among those who have the title of "Doctor," in this land of medical liberty or license, the nomenclature employed in reporting deaths is sometimes very inaccurate and indefinite. I note the following causes of death in the city clerk's register for the present year: "Teething," "worm fever," "pharalithic rheumatism," "canker," "jaundice," "pelvis malformation." There are, however, fewer of such indefinite terms employed, than might be expected. I have reason to believe that all deaths are reported to the undertakers, and by them promptly returned to the city clerk.

78. I am never called upon in any way to report upon the causes of death, —at least have not been in late years.

78½. Our undertaker is a man of thirty years' experience; in early life a carpenter by trade; does not belong to any temperance society; he often has the difficult duty of deciding the *cause* of death from viewing the *cadaver*, and he makes his returns in conformity with his own inquest.

81. Could the public mind be educated up to the point of compulsory autopsies in all cases of death, such autopsies to be performed by duly qualified, legally appointed medical officers, would not both the science of medicine and the art of healing make large advances in our midst during the next half century? What accomplished diagnosticians would arise as one result of such a measure! But this is a Utopian idea; a thing to dream of, but never to be practically realized in this country. I may say, in conclusion, that the registration of *deaths* is "complete and satisfactory," at least very much so in my town. But the registration of the "*causes of death*" is not satisfactory; that is, much less satisfactory.

83. I have practised in this town five years, and have *never* been called upon for certificates of death during that time. The reports of the deaths in the town appear yearly in the clerk's report, but his information is derived from other sources than through physicians.

84. During the past two years, of all deaths returned, not one in three was signed by any physician.

86. The undertakers make prompt returns, but the physicians are not prompt with the *cause*, and the town clerk is obliged to hunt up the cause before the end of the year. In regard to still-born children, if any undertaker is called, he makes a return; if, however, the friends bury the child, no return is made.

89. Cases have occurred in the past, where the body has been taken just across the line into Lawrence, and no return made to the clerk here.

91. All deaths are supposed to be returned; but the causes of deaths, *as returned*, are frequently very unsatisfactory; about one-half are judged to be misnamed.

93. The clerk said, further, that he found it very difficult, in many cases, to obtain the facts and information necessary for him to make the records on the town books complete. Some would be attended by physicians out of town; other families would move out of town soon after a death, without making or leaving any record of the death or cause of death for the clerk. Transient persons, shop hands, etc., would sicken and die suddenly, their friends would come and take their remains to some distant place for interment, without making any returns of the death to the clerk.

94. I had a talk with the town clerk this morning, and he informs me that returns of deaths are not made promptly by the undertakers to him, and that only myself and one other physician make out certificates of causes of death. There are four practising medical men here, and no one but myself appears to be in the practice of making out a certificate immediately after the occurrence of a death. The principal undertaker seldom calls for a certificate, and, the doctors only being required by law to give a certificate

when it is called for, the whole matter is neglected in a majority of the deaths. The present town clerk appears to have tried to get his returns in promptly, but the undertakers and the medical attendants have been careless and remiss.

95. Empirics, often grossly ignorant, report causes in a large proportion of deaths; these reports are received on a par with those of the educated physician.

96. To my mind the registration of deaths and causes of death in this city is not at all satisfactory or complete, when viewed from a medical stand-point. In fact, as far as statistics or the use of such registration in matters affecting the public health are concerned, the matter is a mere farce. I have no means of knowing whether *all* deaths are returned to the undertakers or not. Upon inquiry of the undertakers, I find that they make their return to the city clerk once a month, and that, as a rule, they obtain their knowledge of causes of death from inquiring of the family. Certificates of the causes of death are not given in this city by any physician, they never being requested to do so.

98. In regard to the registration of the *causes* of deaths, there is room and good reason for making a radical change. In a majority of instances, the undertaker makes his return, giving the cause of death and the name of the attending physician from information obtained from the parents or relatives of the deceased. I have in mind an instance which has occurred within ten days, where the cause of death was reported as "pneumonia," and I know, from personal examination, that the party died from "phthisis." It seems to me that in order to obtain a correct registration as to causes of death, and have a report that would be reliable on which to base a statistical report, that it should be made obligatory on the part of the physician in attendance at the time of death of the patient, to sign, in his own handwriting, the undertaker's return, as to the cause of death. Some way should be devised to prevent the undertakers from making their returns, without first obtaining their information as to causes of death from the physician in attendance. As the returns are now made, there is no responsibility on the part of the physician; it is left entirely in the hands of irresponsible parties, and, of course, the attending physician is the only one qualified to make a correct return.

99. I think the attending physician is very seldom interrogated in relation to the matter, and do not know that I ever was. A nearer approximation (I think) would be made to the truth, if every physician were obliged to furnish a certificate to the undertaker or to the clerk of the town, for a record of each death that may occur in his practice, with a penalty, should an undertaker officiate without such certificate.

100. The town clerk informs me that the registration of deaths and the causes of death is *incomplete*; that at least one corpse a month, on the average, is removed from town without any return being made, either of the death itself or of the causes of it.

101. I called upon our undertaker. He informs me that all deaths are returned to him, and he returns them to the clerk. It is not his custom to

call upon physicians in all cases for the cause of death, but takes the statement of the family unless they refer him to the physician. I have no suggestions to offer, but it seems to me the statistics would be much more valuable, if, in every instance, the cause of death was certified by the attending physician.

103. The registration of deaths and causes thereof is satisfactory and correct, so far as I can find out, except that the undertaker or friends of deceased often neglect to present the return of death to the attending physician for his opinion of cause of death and signature, but fill it in themselves, so that omissions and mistakes are frequent. I do not think that I have signed more than half the returns of deaths which have occurred in my own practice for the last eight years.

105. I am seldom asked to fill out a blank, and know but little of the reports.

108. The town clerk's record is well kept, so far as he can be expected to keep it; yet even in the record are evidences that the neglect of the law relating to physicians' certificates occasions much looseness in the record of the causes of death. The law in relation to physicians' certificates, I am informed, has never been enforced here. The town clerk also states, that in his yearly round for obtaining the births for registration, he has occasionally heard of a death which has not been reported to him. Another irregularity has been permitted in allowing undertakers of the neighboring city of Salem and those of the adjoining towns to make their returns of deaths at which they have officiated, semi-annually.

109. I have never been asked to make a certificate of death and the cause of death for any one who has died in this town.

113. It would be an important improvement in the present law if the physician's certificate of cause of death were required *in all cases, without exception*, previous to interment, and cemetery authorities were forbidden to permit any interment except on presentation of an order or certificate from the town clerk. I cannot ascertain that any unrecorded interments have been made here the past two years; but such an occurrence is not at all impossible under existing regulations.

122. The causes of death are at present registered with commendable painstaking by our municipal officers. Only a very small percentage of deaths are registered without a statement of the cause certified to by some medical attendant. But the provisions of the law last enacted to secure a registration are not strictly observed. From the nature of the work, I think the registration of causes of death should be at least subject to the supervision of a medical officer. In our cities this could be made one of the duties of the city physician. Moreover, tables should be furnished to the recording officer and to physicians, indicating the general classification which is to be followed. I think that for the purposes sought through this registration, only a general classification should be attempted. A minute classification is likely to prove useless from the mixture of inaccurate diagnoses from ignorant practitioners, with the opinions of careful observers.

123. The town clerk employs a man to canvass the town every year to collect all the statistics and report to him at the beginning of the year.

125. The town clerk informs me that there are a few returns which are not adequately filled. I cannot control returns of deaths of cases under the care of other physicians, but I am in the habit of calling at the office of the town clerk every year before he forwards his returns, and of assisting him, as far as possible, in making them complete in my department.

131. The registration may be complete, yet I think not wholly satisfactory—the physician's certificate frequently not being called for until several months have elapsed since a death, and then the circumstances not fully in mind. To decide whether such registration is satisfactory or not, I would first know the object of any registration. If for the basis of statistical tables of causes of death, prevalent diseases, etc., I should say not; if to satisfy the public whether the death was from disease or violence, I should say yes.

133. The registration of deaths and the causes of death in this town is very incomplete; beyond the fact that the person is dead, it is of no utility at all. My impression is, that to be of any use, some uniform method should be established throughout the Commonwealth, making it the duty of the attending physician to make and return to some proper officer, within a certain time, a certificate of the death, its immediate cause, etc. As long as every case of diarrhoea in children is called "cholera infantum," and every case attended with cough "consumption," every sudden death "heart disease," what sensible man can peruse the record with confidence?

136. I see but *one* way to make the "returns of death" complete and satisfactory; viz., forbid by law, under penalty, the interment of any body in any cemetery, or transportation in any public conveyance, without a *certificate of death* signed by a physician, countersigned by the town clerk or some other responsible officer; this certificate to be retained by the person in charge of the cemetery or public conveyance, and returned to the officer issuing the same. The person issuing the certificate to be forbidden to give it unless he has in his possession a certificate of death of approved form, and signed by a physician. I have tried all other means, and am convinced that in this city no other plan as feasible will succeed. Many certificates of death have been signed by the undertakers, or not signed at all, and are returned in a lump at the end of the month. Notably is this the case with certain undertakers. The objection that has been urged against enforcing this law, or in fact any reasonable regulation, is, that it is difficult to find the doctor to sign, etc. Pass a law requiring every physician to send to the clerk or other official a certificate of the cause of death within twenty-four hours of death; the city physician or health officer to furnish a certificate, if no physician is in immediate attendance. I am glad that some investigation is being started about this matter.

137½. The same idea (of requiring certificates from physicians) would lead us to prefer that all practitioners should be compelled to have diplomas or certificates of competency before being allowed to follow their profession.

141½. The town clerk thinks some undertakers fail to get and return the required reports, so that some deaths fail of any registration whatever;

others return promptly. Generally, the causes of death are not reported by physicians, but are obtained, as best they may be, from friends' or neighbors' reports of physicians' opinions; often, of course, ill understood and improperly reported. In some cases, the attending physician's name appears as having certified the cause of death, when he has really certified nothing, and only because he was known to have attended the case. Thus my own name appeared as certifying as cause of one death, "Fall at Purgatory"!

142. Out-of-town physicians, as well as resident physicians, have never returned any deaths, nor causes of death, except when the body was to be buried away from this place. For a period of sixteen years I have never been asked nor required to sign a certificate as to the cause of death, except as above stated.

142½. I believe that the nature of the disease or the cause of death is in seventy per cent. of cases mere guesswork. These returns form in many instances the bases of theories from which sanitarians deduce the most positive conclusions.

143. For two years I have neither filled out one [death-certificate] nor even seen one. For aught that I know they may be now obsolete.

147. I have thought that our high death-rate from consumption, as shown by statistics, might perhaps be accounted for in a measure by the fact that the undertaker sometimes, in what he considers a clear case, fills out the blank.

148. The registration of deaths and causes of death here is more satisfactory now than it was a few years ago, and it is intended by the present clerk to make it complete and satisfactory. I think the deaths here have all been recorded. The criticism I make is, that probably the former clerks have sometimes listened to common report as to the cause of death, and so, many of the deaths are recorded "consumption" which are due to other causes. On examining the records for sixteen years ending with 1870, the deaths recorded number 563. Of these, 153 are recorded as caused by consumption, making 27 per cent. of the whole. Comparing this with the years 1871 to 1876, inclusive, to the present time, the deaths recorded number 187. Of these, 27 are reported as caused by consumption (14½ per cent.).

149. The returns of deaths to the undertaker, and the registration of such deaths, have never, at least since my residence here (twenty-three years) been in any degree satisfactory. Such returns, except in individual cases, have been literally valueless. The sexton will ask, either at the time of the funeral or some indefinite time later, some one of the family, What did the deceased die of? and make his return in accordance with the answer and his own ideas of the case, the result requiring an entirely new nosological system to comprehend.

150. The registration is inefficient and unsatisfactory; and principally because of the loose and indefinite way in which the physicians of the town and vicinity record their deaths, the nosology being defective and the cause often omitted as a trivial affair after all. I do not think *all* deaths get recorded, but most do. The undertakers are very prompt to ask for the certificates, but do not always readily get them.

152. I think the value of the returns is much diminished by the certificates of irregular and ignorant practitioners being received, but as such attend quite a large proportion of the sick everywhere I see no present remedy.

153. From inquiries, I judge that all deaths are returned to the undertakers, and quite promptly by them to the town clerk. The certificates are fully made out, but I find that the undertakers seldom obtain the names of the diseases and their causes from the attending physicians, and no doubt they are not unfrequently incorrectly stated. On this I would make a suggestion. The law does not oblige the attending physician to return the name and sex of the deceased, the disease and its causes, except when *requested*. My suggestion is to have the law changed so as to make it obligatory on the part of the attending physician to return the name and sex of the deceased, the name of the disease and its cause, to the town or city clerk; and on the part of the undertaker to obtain the name of the disease and its cause from the attending physician, the certificates retaining their present form.

154. I think they [deaths] are all returned to the town clerk, but I see by examination to-day, of those for 1876 to date, that the disease is not stated by the attending physician in more than one-half of the certificates.

156. I doubt if in every case of death the cause is certified by a medical man, for the reason that a certain number die every year without medical attendance, and under such circumstances that no physician could make an unconditional return without a post-mortem examination. In such cases, one can give a medical certificate to be used by parties known and supposed to be honest, with a declaration that it is based upon the representations of parents or friends. Such a document may be absolutely necessary to facilitate interment.

157. I have reason to believe that the causes of death are very indifferently reported. Physicians' certificates are not always required.

157½. The deficiencies in the first place are with the undertakers, or those having the care of the funeral, or of the body of the deceased, to ascertain the facts in regard to the cause of death. In many cases the medical attendant is not even asked for the cause of death, or not even what ailed the patient; and when the return is made up there is some cause assigned in the certificate which does or does not represent the true cause of the death, and therefore not reliable for accurate statistical information. For an example, which occurred in my own practice: A gentleman died from cancer of the bladder and prostate gland, of several years' duration; it was returned as kidney disease, or complaint. The undertaker was informed by myself of the true cause of the disease, while, as he says, the family said it was kidney disease, and he thought they ought to know best, and so he made his return as kidney disease; and I find in my examination of the register very many errors of a like kind. It is my impression, and in fact I know, that the cause of death is not very generally reported by physicians in this town unless called for; perhaps more so now than formerly, for I have been urging the undertakers to be more particular in regard to the matter of ascertaining the true cause of death, and fulfilling all the requirements of the laws of registration. Another fault is, the returns are not promptly made at the

time of death and burial. The return is often delayed for one or two months, and even longer, and has even been delayed until after the annual return has been made to the secretary of the Commonwealth. This fact came under my own observation, for the returns were handed to me by the undertaker, saying that he forgot to hand them in before, and supposed that it would make no difference, as he was in the habit of making his returns but once a year.

161. The town sexton reports all deaths to the town clerk once a year, bringing the *blank forms* to the physicians for them to fill out, guessing, as near as can be done, when, from any cause, physicians are unable to certify advisedly. My belief is, that if the sextons were required to report *every month at least*, in country towns, the business would be performed more satisfactorily and with more exactness. Copies of the statutes relating to the matter should be posted up in some conspicuous place in town,—in the post-office, for instance,—so that all parties desiring to know what is law and usage, can thus be informed.

162. The returns are hardly ever filled and given to the registrar until the close of the year, which might, in some cases, make a little jar in the correct filling of blanks. The sexton usually brings his blank to me at the close of the year to be revised and filled as to points he is unable to do himself; in some cases, the death is so far back, that I am unable to be as correct as I would like. I do not say this to find fault with the sexton, for I think him to be a very careful man; it has been the custom for years, and he has only followed the custom.

163. The causes of death are sometimes certified to by a physician, if he is handy; if not, any one considers himself competent to assign the cause. In reply to the question, "Are three out of five certified to by physicians?" he (the town clerk) said, "No, not so many."

164. When undertakers are employed, they generally obtain certificates of causes of death from the physician in charge; but there are quite a number of burials by the family, where no undertaker is called upon, and in these cases no record is returned, unless the physician makes a point of returning the case himself, which few do.

170. I think the registration, as far as the name of the person is concerned, is complete and accurate, but of the causes of death, very inaccurate and deficient. The returns are made by the undertakers to the city clerk every week, and, as far as I know, they make returns of *all* the deaths, excepting in some cases of still-birth. But the causes assigned by the undertakers, in many cases, are very inaccurate and ridiculous, and in some instances with intentional deception. It is rare for the physicians to report the causes of the deaths.

171. Deaths are returned by the undertakers to the clerks, they inserting the cause of death, and simply guessing at it. No certificate has ever been presented to me for signature or filling by undertakers.

172. While perhaps all cases of death may be reported by the undertakers to the clerks, the causes are provokingly inaccurate, for the reason that

physicians are not required to return the causes of death, and the undertakers make returns of what they may be able to gather from the family.

179. For many years I have been so disgusted with the manner of conducting this business, that I have lost all interest in the matter.

180. Judging from returns of deaths coming under my own observation, I should say that undertakers are careful to make returns. In looking over the returns of *causes* of death in the clerk's office, I should give my opinion that tables made from them would be of little value.

182. I do not think all deaths are reported to the clerks—certainly not promptly. They are not returned by the physicians, but by the undertaker, who reports the cause of death as received from the friends. I have corrected the returns for the town clerk, as well as I could, for the past four or five years, but, of course, was not always sure of giving the accurate cause of death in every case, except where I have been the attendant.

185. In the main, I have long regarded the returns of deaths very imperfect. For instance, there were some 40 deaths returned by the clerk last year, and on my private list of deaths, which I keep from year to year, I had recorded 60.

190. The returns are made pretty promptly every week. As to the causes of death, the returns are as unreliable as is popular rumor in general, for that is all they amount to. The cause of death *very* rarely comes direct from any physician. I wish you would suggest the best way of remedying this matter; of making these comparatively worthless records what they might be—a valuable store of facts. For we shall probably have an available mayor next year.

191. I am glad you are going to present the subject of registration. It is one which has interested me for a long time. I have resolutely tried to have the system changed here, but to no purpose, as the city government has been changed every year; and I have not been able to get the mayor interested until the end of the year, when he has been turned out for a new man.

INFORMATION FROM TOWN AND CITY CLERKS.

Two hundred and sixty-two clerks replied to the circulars, as follows :—

Registration of number of deaths satisfactory,	.	.	102
“ “ “ not satisfactory,	.	.	43
Replies indefinite,	.	.	117
Registration of causes of death satisfactory,	.	.	50
“ “ “ not satisfactory,	.	.	113
Replies indefinite,	.	.	99

There were 144 cities and towns from which both medical correspondents and clerks answered. In these—

Town clerks and medical correspondents agree in . . .	70
“ “ “ do not agree in	74
“ say satisfactory, and medical correspondents	
say not, in	15
Medical correspondents say satisfactory, and town and	
city clerks say not, in	8

Fifty-one of the seventy-four discrepancies in the replies are where one reports “indefinitely,” and, therefore, are not strictly at variance.

Under the first head the clerks evidently often mean that their part of the work is satisfactory, and sometimes even say that the medical correspondents might think otherwise. Again, after saying that everything is satisfactory, they often add that they get returns only once a year by going for them personally, and one calls it satisfactory when he gets physicians’ certificates only “in more than fifty per cent. of the cases”; others call the registration satisfactory, when they have not heard complaints. Some say that they have not given the subject much attention. One “cannot spare the time to give the subject that consideration which it deserves.”

One clerk states that, in his opinion, all deaths are reported, but adds that he has often wondered why it was that “consumption, cancer, and heart disease prevail here” so extensively. In this remark lies the key to the fact that prevalent diseases are reported in excess of what is due. So it is commonly, or at least often, that wasting diseases are classified as *consumption*; infantile diseases as *cholera infantum*, etc. For the same reason, during epidemics of scarlet fever and cerebro-spinal meningitis, the mortality from those diseases appears very much exaggerated. This was notably true of diphtheria in our State in 1874 and 1875.

Many of the clerks remain in office only a short time, and do not really have their attention called to the subject farther than to follow precedents. Sometimes an efficient clerk gets his registration well in hand, and the next turn of the political wheel removes him and brings in another. It is, therefore, impossible to say that the error in our returns is nearly the same from year to year.

When the registration has been satisfactory, it has usually

been due to a local board of health, or to the gratuitous labor of some interested clerk, who does the work which, by the law, belongs to some one else. One of them even says, for instance, that the clerk has about as much work in making out his return at the end of the year as if the undertakers and physicians had nothing to do with it.

By the personal efforts of the clerks, weekly returns are made of deaths and causes of death in the nineteen large towns and cities of the State; but even in some of the largest cities, there are still such imperfections in the registration that these returns are only approximate. The difficulty of fixing the responsibility for accurate registration on any one person is evidently working badly, and some of the replies to our circulars contain this statement.

It was not a part of the present plan to investigate the registration of births, and no questions bearing upon that matter were asked. Undoubtedly the liberal fee (when much travelling is not needed) stimulates the desire to get all cases. Still, some of the circulars were returned with the statement that the registration of births is even more unsatisfactory than that of deaths.

The defects pointed out in our records of vital statistics are manifestly such that they cannot be rectified in the painstaking and able elaboration of them for publication, nor explained by the high professional talent employed in editing them.

Replies of City and Town Clerks.

8. The custom has been to return the deaths at the end of the year, except when the body is carried out of town for burial; then I get a return near the date of death. I very seldom get the physician's certificate with the return; the cause of death is usually named, also the name of the physician; but all in the handwriting of the undertaker, and I think it is obtained from some member of the family of the deceased. I think the disease or cause of death is in many cases guessed at, so that my return to the department is not accurate as to the prevailing disease.

10. I find that about six-sevenths of the returns are made by the undertakers; the other one-seventh seem to have been made by friends of the deceased, rather than by physicians. The undertakers may have received their information from physicians for aught I know.

15. In answer to your inquiries, I would say that our undertaker makes full returns of all deaths where he officiates, but that is not in one-half of the cases. There are undertakers who come into this town and remove the

dead and make no returns; but when I go through the town for the births, and find a death, I get the best information I can.

17. The undertaker is furnished with blanks to fill, and he gets the best information he can from the family of the deceased, when making preparations for the funeral. These certificates are returned to the town clerk for registration at the close of each year. They usually contain some kind of a statement of the causes of death, sometimes attested by a physician and sometimes not. A section of our town always go to P—— for an undertaker, and the town clerk never gets any returns except such as he can gather when canvassing for the particulars concerning births. From this section, information as to the causes of deaths is very unsatisfactory.

19. I fear that in some towns not one-half the *causes* of death are obtained.

20. In small towns like this, where there is no undertaker, we do not get all the returns, and, if the clerk goes after them, it is very doubtful if he gets the cause of death correct.

24. A great many causes of death are returned as "heart disease," and nothing more. That disease assumes so many forms I have thought whether to medical men that was satisfactory.

27. I have never had reason to suspect any inaccuracy except in one instance, returned as "inflammation of stomach," where the death was probably caused by an attempt at abortion.

29. It has become unfashionable to comply with the requisitions of the statutes, and, if any officer points out this neglect of duty, he is answered that other town clerks are not so particular, and that no one lives up to the laws.

31. The law is in no case complied with, either as regards the undertaker, physician, or by the families themselves. At the close of the year, the births and deaths of the year past are collected by going from house to house throughout the town, making the result very unsatisfactory and expensive.

36. I think all the deaths substantially are reported to the undertakers, and most of these return the *deaths* promptly and accurately, but not the *causes* of death. In the case of private cemeteries, some of the undertakers make no attempt to obtain certificates. One undertaker in this city has always been in arrears, more than all other undertakers together. I showed him this circular, and he has since brought in all the certificates that were wanting, to date. In some cases no physician is employed, and we have no "city physician" to investigate the cause of death. Incompetent persons, quacks of both sexes, midwives, professional or non-professional, are employed in some cases, and their certificates are incorrect or worthless. Some of the regular physicians give a great deal of unnecessary trouble to the undertakers, who are often obliged to go many times before they can get a certificate. If the attention of physicians could be called to this matter, and if undertakers could know that they were liable to removal for not making full returns, most of the present difficulties would be removed.

38. There are not more than one-eighth of the causes of death certified to by physicians.

40. Returns are sometimes made with the cause of death omitted, or inserted by the person making the return, and too often stated in a vague or general way. Unless a permit for removal of a body is required, undertakers do not make their returns, as a rule, until the close of the year.

43. The certificates of physicians as to causes of death are rarely received at this office, and the record is dependent on the undertaker's certificate.

54. We have not any undertaker, but we usually employ those from the city of New Bedford, and they do not take the pains to make any returns in one-half the cases or more, and I seldom get the cause of death reported by a physician.

68. I should say that all the facts I report in about fifty per cent. of the deaths, I obtain as best I can.

74. During the present year, I have furnished the physicians and undertakers with all the proper blanks, together with pamphlet of instructions, but up to the present time not a single death has been returned to this office.

76. I think our registration of deaths is about as complete as you could have it. Whether we get the *causes* of deaths as accurate as possible, is a matter the physicians know best about. I don't think we do, in each and every case.

79. It has been my practice for quite a number of years past, when clerk, to visit or send some competent person to visit the families where births and deaths have occurred, and to ascertain the facts and particulars before making returns to Boston.

88. Physicians do not report any cases at all.

90. I have been clerk of the town for six years in succession, and have employed a man to gather all the information in regard to births and deaths called for in the blanks sent to me for that purpose. I have never received any information from physicians or undertakers.

93. If I were to make any suggestion, it would be that the people, especially in the small towns like ours, be in some way reminded by the state authorities of *their* duty in the matter of returning deaths, and other vital statistics, to the town clerk. As before stated, it now seems to remain with the clerk, in our town at least, to collect the facts concerning such deaths as may come to his knowledge, and it is only by keeping a close watch that he can be at all confident of accuracy.

94. The physicians' reports do not come so easily. The reason, I think, is, that the friends do not know that such a thing is required, so come unprepared, then of course forget to see the "Medicus," and the matter slips over. We have but one physician here. I see him occasionally, and fill up cases that he knows about, but many people employ doctors from the neighboring villages, and so I sometimes lose one.

95. I also am quite sure that the undertaker obtains his information in regard to the cause of death, in a majority of cases, from some member of the family, rather than from the physician. The reports of causes of deaths are incomplete.

97. Never until this year, has the returning of deaths been made in a proper manner; and I determined that I would have it properly done if the law was good for anything. I accordingly sent to or saw every physician and undertaker in the city and told them what I wanted to do, and that I must have their coöperation and assistance. I have had it, and must say that I am very well satisfied. It is only in the cases of those who are too poor to employ medical services, that the cause of death is not reported.

108. I have been in the custom of getting the cause of death indirectly from the undertakers through the superintendent of burials, who is a physician, and can give the technical name, which we would fail to get if we relied on the undertaker's return, especially in cases where there was no physician in attendance. The undertakers complain that they have difficulty in obtaining the cause of death from the physician in attendance, in time to make the return to the city clerk within the time required by law. The registration in this city has been very complete and satisfactory, especially for the last three or four years.

115. The causes of death, as returned by the undertakers, are not always correct, as they do not obtain the certificate of the attending physician. I therefore get the doctor's statement myself, and often find that it does not agree with the undertaker's return, which is made up from statements by the family of the deceased.

119. The causes of deaths are not generally made known, except in an incomplete and unsatisfactory way.

122. I have experienced some difficulty in obtaining the physicians' certificates as to the cause, etc.; that is to say, they delay the matter, and will not fill them out until solicited to do so by some one. I have always obtained or received them after a time. If they were required to fill them out *immediately*, the returns would be more accurate, and it would certainly assist matters.

123. I have physicians' reports of causes of death in 60 per cent. of the number of deaths.

126. There being no resident physician in active practice here, the people are obliged to employ physicians from other towns, rendering it impracticable, in many cases, to obtain the physician's certificate of the cause of death. Somewhat less than one-half of the deaths are so certified. All deaths are promptly returned by the undertaker, with a statement in each case of the cause of death, as correctly as it can be ascertained from the friends of the deceased.

127. In this town I think all the deaths are registered—the facts being returned to the clerk by the undertakers, each week, they are surer to be right than if returned monthly; this I know by experience; for, when

returned monthly, as required by the statutes, it would often happen that some would be delayed for two or three months, and I found more difficulty in having them corrected. No certificates of the cause of death are ever given in this town by the physicians ; hence the cause of death, as returned to me, is very imperfect, in my opinion.

129. The cause of death is not returned in more than one-fourth the cases, and I have been obliged to ascertain it and, in many instances, to fill the returns myself. I think there should be some method by which the returns of deaths may be made more complete.

131. The only difficulty that I have experienced from the undertaker (for it is usually the same person from year to year) is, that he will insist upon keeping his returns until the end of the year, and making them in a body.

132. In answer to your circular of the 1st inst., I have to say that since my connection with this office I have found it almost impossible to get the complete returns of deaths from the undertaker. I have taken it upon myself to obtain them, and believe that, for the past nine months, the registration has been complete, except in a comparatively few cases, where physicians have neglected to make returns of "causes of death," when frequent applications have been made for them. How to remedy this neglect on the part of physicians and undertakers in small towns, is, in my opinion, a difficult matter to solve, unless, perhaps, the whole duty of obtaining all the facts relating to a death be assigned to one person.

135. In answer to your inquiries, I will state my impressions. I have kept the records since the year 1870, and have endeavored to have them correct. The rules and regulations of the board of health, in this city, are so well observed that every death is recorded, and the cause of death, as returned, is usually correct. If I have any doubt, I immediately send a blank to the physician, and leave the filling of the record until I have it returned.

136. To my knowledge, physicians' certificates of causes of deaths have never been called for or reported by them, with, perhaps, one or two exceptions, occurring some years ago.

139. I consider the registration very nearly complete in this town ; the only deficiency being now and then a body removed from town for burial elsewhere, without application for a permit. I think there may be twelve such cases in a year ; the number registered being from two to three hundred. The causes of death are given in all cases. In this town the returns are made to the clerk by the sexton who has charge of the burial, so that we are sure of returns of every interment. The sextons make these returns on the proper blanks, once in six months.

142. It is quite too common that the cause is not certified by a physician, especially in cases where no physician is in attendance ; and I have heard the sexton say frequently that the doctors were rather indifferent as to the performance of the duty.

146. I think the present system of registration in case of deaths works well in this town of about nine hundred inhabitants. Our undertaker is

very careful to make *full* returns of *all* deaths; in nearly every instance the cause of death is reported and recorded. I presume more difficulty would be experienced in securing full returns in larger towns, especially among the foreign element.

147. Strangers sometimes die and are removed to a distance for burial. Such are liable to be overlooked, as they rarely call on the town clerk for a license to remove the body, probably through ignorance that the law requires it. It might be well to prohibit railroad employes from passing such over the road without having a license pasted on the top of the box.

158. In towns of over ten thousand inhabitants, it would seem that undertakers should make their returns at once, as soon as they are employed, and not be allowed a grace of seven days. The physician should make his certificate and leave it with the family or persons having care of the deceased at once after death, and not have fifteen days of grace. If the physician attends to his duty, then the undertaker has most of the information required; and it would be only a moment's work to fill up the necessary return complete, and the town clerk, with limited means for information, would not be obliged to supply all deficiencies, which is almost impossible in a town so large as this.

We have two large cemeteries here, and the smaller towns send during the year a great many bodies to be buried here. In such case, we have to be without any "permit to remove" or a physician's original certificate, and have to take the word of the undertaker, who fills the blank according to what he may have remembered being told or heard. In many cases, corrections have been made at my own expense, but I have not been and am not able to give my whole attention to this particular branch of my duties. In most of these out-of-town cases, the undertaker waits ten days, and oftener two or three weeks, before making any return; the record is then, at best, very meagre, and there is no way to make a full return. Everybody has shirked the matter or been careless, and all the town clerk has to do is to supply deficiencies and give the undertaker a permit, because the cemetery corporation has allowed the burial without a permit and the undertaker has really done the best he could (?). If the railroad and express companies would not receive a body unless there is the proper certificate of removal accompanying it, and if the cemeteries would not allow a body to be buried without a "permit to bury," I think the difficulty would be overcome. This might not be easy to carry out in small towns at first, but in large towns of ten thousand inhabitants and over, there would be no trouble after a few weeks, if the physician and undertaker would make their certificates as suggested.

We rarely use the "physician's certificate," but, instead, use the one on the return blank. I have tried my best to have the first used, but have given it up. There are so many "holes" in the statute that all we can do is "the best we can." I do not know that I can suggest anything in regard to registration, but can give you information regarding the work in this town and hope that we are not behind our neighbors.

The average of time between decease and registration is about ten days. Permits to bury are granted in all our cases, but always after interment. In removal from town, our undertakers always get a "permit." We rarely use a physician's certificate-blank. In most cases, we are able to get a

physician's certificate to the return; in case there is no doctor in attendance, we do without. We rarely receive permits to remove, with bodies coming from other towns in the State, excepting, always, the large cities.

159. In a town of this size, there is not much danger that *any death* will escape registration. People seldom die here except from *old age*.

165. Causes are not reported by the physicians as they should be, but, in more than half the deaths, causes are obtained from physicians before any record is made.

168. As we are situated near the state line of Rhode Island, undertakers come from Providence, take charge of funerals and do not make any returns to me. For the last two years, since I have been town clerk, I remember of but one instance, in about twenty such cases, where they have made the returns that our law requires.

169. The deaths are not all returned by the undertakers, but the fault seems to be with physicians, who are very negligent in the performance of that duty. At least twenty-five per cent. of the deaths, in this town, are reported from other sources.

172. Probably the causes of about one-quarter of the deaths are certified to by a physician. The town is so small that the physician's certificate is not necessary, as the cause is known generally.

179. The registration of deaths in this town is all correct, so far as we can obtain returns, but the returns are not as prompt and certain as they should be. There were two or three deaths in town last year that were not reported, I have since learned, and they are not all returned in the manner the law directs.

180. In reply to your circular received a short time since, I will say that neither the undertakers nor physicians make any report whatever in regard to deaths or the causes thereof. I have, at my own expense, sent a man over the town each year since I have been town clerk, with instructions to get *all* the facts and every name of persons who have died during said year. As to the accuracy of what he is able to gather respecting the "causes of death," you can judge better than I. The friends report what they have understood the physician to say was the disease or cause of death.

182. The registration of the number of deaths is probably complete; causes, perhaps, not fully satisfactory, blanks for "returns of deaths" being seldom filled by the attendant physician, but by the acting undertaker or some individual chosen by the family of the deceased to take charge of the funeral ceremonies.

186. The cause of death gives me most trouble. When families are not able to state it, I make a point of ascertaining it from the attending physician, and do not always get it then.

195. Of the 64 deaths registered here in 1875, 46 were certified by physicians, and the proportion is probably not very different from that in past years.

196. Of all returns made, from fifty to sixty per cent. are certified by physicians.

216. The great deficiency is in regard to the causes of death; very few physicians' certificates are furnished, and the information of the undertakers, obtained from the families, is often partial and inaccurate.

219. Nearly all the returns of the fact of death are promptly reported. There are some cases omitted where a sexton from out of town is employed, and in them I endeavor to supply the deficiency, as far as possible, when looking up the births.

225. I think the registration is quite complete, and that the deaths are very fully registered. The causes of deaths are not nearly so satisfactory, the undertaker getting the information from the family, and, I think, quite rarely from the physician. I remedy this as much as possible by taking them to the physician myself at the end of the year and getting him to revise them. I send you a few samples of causes of death, by which you will see the necessity for revision. If sextons were obliged, in all cases where there is an attending physician, to get the information from them, it would improve the character of the returns.

230. The undertaker has generally left a blank at the time of the interment, which, in some cases, has been retained to nearly the close of the year, and I have been obliged to hunt them up myself. Of thirteen returned to me the present year, six were without the cause of death certified by any physician.

237. About half of the deaths are returned. The remainder are obtained by the clerk as he collects the births. Only in a few cases are the causes of death accurately and specifically given, the clerk being obliged to supplement that part of the work. Very few, if any, of the regular blanks are used, although there have always been plenty in the office here for that purpose.

242. But very few of the causes of death are returned by physicians. None of our leading physicians have made any returns for some years, and never did so except in a very few cases. Some eight years since, I furnished all the physicians in this city with blank certificates for them to make returns of the cause of death, and only received a limited number of them.

243. The causes of deaths are not returned generally as they should be.

244. The returns by undertakers are made promptly, and I think I get them all except in case of foreigners who remove for burial. Sometimes they are not returned. The causes of deaths returned are not perhaps always satisfactory.

245. In many cases, the causes of death are reported according to the received belief of the family and neighborhood. I get such returns as "died by the visitation of God," or "by the hand of God," quite often; and "heart disease" and "old age" constantly. When I know little or nothing about the case, I make the record according to the undertaker's return. In other cases, although I am no physician, scientific or otherwise, I exercise some little discrimination of my own.

246. I would say that for six years that I have been clerk of this town, but one death has been returned to me by the parties required by law to do so.

247. Probably three-fourths of the death-reports are accompanied by a statement of causes. I usually call upon the physicians a second time; *i. e.*, after the undertaker. In this way, I get most of them complete, but not any too accurate, I fear.

250. I cannot recall a single instance, during the nine years I have been clerk of this town, of having received a physician's certificate of cause of death; and the causes, as reported by undertakers' returns, are in many instances inaccurate and incomplete.

254. Three or four years ago, when cerebro-spinal meningitis was prevalent, I had from this class (irregular practitioners) one or two deaths returned from that disease, when I thought I knew absolutely that the cause of death was entirely different. In such case, has not the town clerk the power to alter and correct the returns? *I do.*

HISTORY OF REGISTRATION OF DEATHS.

In considering how to avert the recurrence of the terrible plagues which visited London in the sixteenth century, the first step was to find where and under what circumstances people died, and how variously different localities were affected. For this purpose registration was organized, imperfect, it is true, but sufficient to give many important hints. Much later, when the Poor-Law Board was created, a better system of registration was adopted; but it was only in 1837 that it was carried out with all the force of an Act of Parliament, and with the coöperation of the physicians, surgeons and apothecaries promised by the presidents of their associations. The law has been improved from time to time by many amendments; and finally physicians were compelled to return certificates of death under penalty, in 1874, as was then already the law in Scotland.

To such a high degree of perfection has registration of deaths now arrived in England, that on each Tuesday a printed pamphlet of ten pages is prepared and sent over the kingdom, giving the causes of deaths, etc., with the conclusions and warnings to be drawn from them, *for the week ending the previous Saturday*, and collected from twenty-three towns, containing over eight million inhabitants. This return also contains the latest information from the large cities of the

world,—from New York and Philadelphia to Calcutta and Bombay,—and fully justifies Dr. Farr's enthusiastic remark, that "Thus observers, like watchmen on the walls, are ever on the lookout, so that they see exactly what is going on, and neither plague, cholera, nor any other great epidemic can take the nations by surprise." * Quarterly, yearly and decennial reports are also published.

The Imperial Board of Health of Germany have taken steps to collect and publish similar returns *promptly* from all cities in the empire containing 15,000 inhabitants and over, especially with reference to getting early information in regard to epidemics.

Our registration in Massachusetts followed four years after that of England, and is so similar as to justify the inference that it was taken almost directly from it.

The law of Massachusetts regarding registration (chapter 21 of the General Statutes) is as follows, the amendments being inserted in the places where they belong:—

SECTION 1. The clerk of each city and town shall receive or obtain, and record and index, the following facts concerning the births, marriages, and deaths therein, separately, numbering and recording the same in the order in which he receives them, designating in separate columns:

In the record of births, the date of the birth, the place of birth, the name of the child (if it have any), the sex and color of the child, the names and the places of birth of the parents, the occupation of the father, the residence of the parents, and the date of the record;

In the record of marriages, the date of the marriage, the place of marriage, the name, residence, and official station of the person by whom married, the names and the places of birth of the parties, the residence of each, the age and color of each, the condition of each (whether single or widowed), the occupation, the names of the parents, and the date of the record;

In the record of deaths, the date of the death, the name of the deceased, the sex, the color, the condition (whether single, widowed, or married), the age, the residence, the occupation, the place of death, the place of birth, the names and places of birth of the parents, the disease or cause of death, the place of burial, and the date of the record.

SECTION 2. Parents shall give notice to the clerk of their city or town of the births and deaths of their children; every householder shall give like notice of every birth and death happening in his house; the eldest person next of kin shall give such notice of the death of his kindred; the keeper of a workhouse, house of correction, prison, hospital, or almshouse, except the state almshouses at Tewksbury, Bridgewater, and Monson, and the master or other commanding officer of any ship shall give like notice of every birth and death happening among the persons under his charge. Whoever neg-

* 37th Report, p. vi.

lects to give such notice for the space of six months after a birth or death, shall forfeit a sum not exceeding five dollars.

SECTION 3. Any physician having attended a person during his last illness, shall—when requested within fifteen days after the decease of such person—forthwith furnish for registration a certificate of the duration of the last sickness, the disease of which the person died, and the date of his decease, as nearly as he can state the same. If any physician refuses or neglects to make such certificate, he shall forfeit and pay the sum of ten dollars to the use of the town in which he resides.

SECTION 4. Every sexton, undertaker, or other person having charge of a burial-ground, or the superintendent of burials having charge of the obsequies or funeral rites preliminary to the interment of a human body, shall forthwith obtain and return to the clerk of the city or town in which the deceased resided or the death occurred, the facts required by this chapter to be recorded by said officer, concerning the deceased, and the person making such return shall receive from his city or town the fee of ten [as amended, *twenty-five*] cents therefor.

The clerk, upon recording such facts, shall forthwith give to the person making such return, a certificate that such return has been made, which certificate such person shall deliver to the person having charge of the interment, if other than himself, before the burial when practicable, otherwise within seven days thereafter. When a burial takes place and no certificate is delivered as aforesaid, the sexton, undertaker, or other person having charge of the interment, shall forthwith give notice thereof to the clerk, under penalty of twenty dollars.

SECTION 5. The clerk of each city and town shall annually on or before the first day of February [as amended, *March*] transmit to the secretary of the Commonwealth, certified copies of the records of the births, marriages, and deaths which have occurred therein during the year ending on the last day of the preceding December.

SECTION 6. The record of the town clerk relative to any birth, marriage, or death shall be *prima facie* evidence, in legal proceedings, of the facts recorded. The certificate signed by the town clerk for the time being shall be admissible as evidence of any such record.

SECTION 7. The clerk shall receive from his city or town for obtaining, recording, indexing, and returning to the secretary of the Commonwealth, the facts in relation to a birth, twenty [as amended, *fifty*] cents; a marriage, ten [as amended, *fifteen*] cents; a death, twenty cents for each of the first twenty entries, and ten cents for each subsequent entry [as amended, *if returned as provided in sections 2, 3 and 4; if obtained by the clerk himself, the fee is thirty-five cents*], as the same shall be certified by the secretary of the Commonwealth; but a city or town containing more than ten thousand inhabitants may limit the aggregate compensation allowed to their clerk. He shall forfeit a sum not less than twenty nor more than one hundred dollars for each refusal or neglect to perform any duty required of him by this chapter.

SECTION 8. The superintendents of the state almshouses at Tewksbury, Bridgewater and Monson shall obtain, record and make return of the facts in relation to the births and deaths which occur in their respective institutions, in like manner as is required of town clerks. The clerks of said towns shall, in relation to the births and deaths of persons in said almshouses, be exempt from the duties otherwise required of them by this chapter.

SECTION 9. The secretary shall, at the expense of the Commonwealth, pre-

pare and furnish to the clerks of the several cities and towns, and to the superintendents of the state almshouses, blank books of suitable quality and size to be used as books of record under this chapter, blank books for indexes thereto, and blank forms for returns, on paper of uniform size; and shall accompany the same with such instructions and explanations as may be necessary and useful. City and town clerks shall make such distribution of blank forms of returns furnished by the secretary as he shall direct.

SECTION 10. The secretary shall cause the returns received by him for each year to be bound together in one or more volumes, with indexes thereto. He shall prepare from the returns such tabular results as will render them of practical utility, make report thereof annually to the legislature, and do all other acts necessary to carry into effect the provisions of this chapter.

SECTION 11. Any city or town containing more than ten thousand inhabitants may choose a person other than the clerk to be registrar, who shall be sworn, and to whom all the provisions of this chapter concerning clerks shall apply. The returns and notices required to be made and given to clerks shall be made and given to such registrar, under like penalties.

SECTION 12. The secretary of this Commonwealth shall prosecute, by an action of tort, in the name of the Commonwealth, for the recovery of any penalty or forfeiture imposed by this chapter.

SECTION 13. Any city or town may make rules and regulations to enforce the provisions of this chapter, or to secure a more perfect registration of births, marriages and deaths therein.

FAULTS IN OUR LAW.

From failure to enforce this law in some cases, and in others from its inadequacy, there are many defects in our vital statistics which may be remedied. Of course, there will be some errors always. There are some cases in which it is impossible to state accurately the cause of death without an autopsy, and it cannot always be done then. The best men will make some mistakes, and charlatans will make a great many.

It is important, therefore, that in all cases of sudden death at least, and better still, in all cases, the physician's certificate should state whether there was an autopsy, as is done now in Watertown at Dr. Hosmer's suggestion. Competent physicians, too, should be registered, as in England; and reports signed by others, or where for any reason no physician was able to get sufficient information as to cause of death, should be classified as uncertified.

Errors arise, too, from want of uniformity in the practice of physicians as to certifying causes of death. For instance, of three persons dying from typhoid fever, suppose the *immediate* cause of death in one to be exhaustion, in another intes-

tinal hemorrhage, and in a third pneumonia. Here are four "causes of death" as now happens; namely, "typhoid fever," "exhaustion" (consumption the undertakers call it), "hemorrhage" and "pneumonia." They should all be certified as typhoid fever, and the other facts should be stated. Instructions relative to this and other kindred matters should be given from the central office.

The infant who was reported as having died of "canker rash, diphtheria, dysentery and consumption," and another, whose cause of death was returned as "five doctors," doubtless had good reason to die; and "delicate from birth," "infancy," "stopage," "fitts," "colera fantum," "collocinphanton," "cholry fanton," "bled," "direars" (? diarrhoea), "billirm (? delirium) feever," "artry lung bursted," "feusson (? effusion) on brane," "canker on brain" and "infirmation lungs" probably convey some ideas to the persons who wrote the terms; but such returns cannot be of much use in a statistical point of view.

For sudden deaths, and where no physician has been in attendance before death, the selectmen should be required to call upon some medical man for the best certificate possible under the circumstances. Inquests will often be needed, but the question of coroners* is too broad and important to be touched upon here, further than to say that many now in office are grossly incompetent, and that abuses are too common.

In Europe many persons die without medical care; and especially in some of the more populous places, *leichenbeschauer* and *médecins vérificateurs* (examiners) are employed by the city or by the state to learn the circumstances of death; but this is chiefly to ascertain that the death was not by foul means.

Where the town clerk rides about his circuit at the end of the year to collect the births and deaths, some must

* One of our correspondents writes: "I submitted the suggestion concerning the appointment of coroners, or investing physicians who may be members of local board of health with the powers exercised by those officers, to one of our most prominent lawyers, who cordially approved them, and wished me to write more at large upon the subject. I will not do so, however, further than to say that in this town of 6,000 inhabitants there is no coroner, and there has been none for the last forty years; nor is there, to my knowledge, at this time, one within twenty miles. So the impediments in the way of the judicial action that circumstances sometimes demand in the name of justice are very great."

inevitably be lost by removal of families, forgetfulness, etc. Where the undertaker makes his reports only at long intervals, of course some will be overlooked.

Generally, physicians readily give certificates when asked for them, so that this evil of delay may be avoided. If, however, the family or friends of the deceased were responsible for getting the doctor's certificate and the registrar's permit, the doctors would undoubtedly take much more pains to have their part of the duty promptly done. The people would soon get accustomed to so reasonable a law, as they have already done in England, and as they have done here (in some towns) when the body is to be removed to a distance for burial, or in the case of marriage certificates. In such case there would be no reason why the undertakers should have their present fees.

To make the law fully operative, there should be a penalty for burying in any private or public cemetery without a permit, to be enforced equally upon keepers of cemeteries and individuals. Exceptionally it might be necessary, in case of contagious diseases, in scattered communities, etc., to allow the permission of the selectmen or health officer to suffice, leaving the certificate to be returned later.

Railways and public conveyances now carry bodies without permits, and such bodies are conveyed pretty much over the State, either for interment or reinterment. Of course, this should never be; in case of a contagious disease, it might involve serious danger to the public health.

For the increased duties which town clerks would have under better enforcement of the registration laws, and with more efficient regulations, the present fee for registration of deaths is, in some cases, rather small, but it need not be as large as the clerk's and the undertaker's together now amount to.

The section of the law by which "any city or town may make rules and regulations to enforce the provisions of this chapter or to secure a more perfect registration of births, marriages and deaths therein," is apparently not often acted upon; but it has been done in a few cases. The boards of health of Boston and of Brookline have done very efficient service in this regard; and one of our correspondents writes :

"The registration of deaths in Woburn is complete and satisfactory. Physicians are required to make returns of the cause of death in *every case*, before the town clerk will issue a permit to the sexton for burial."

IMPORTANCE OF REGISTRATION.

It is not too much to say that modern sanitary science owes its existence to the registration of deaths and the localization thereby of insanitary conditions. It has been very much advanced, too, by the careful enumeration of cases of sickness as well as of deaths, whereby epidemics and locally prevalent diseases have furnished the means of scientific study, from which general laws have been learned, and through which state medicine has become a necessity of modern life.

REGISTRATION OF DISEASES.

As soon as it was recognized as a part of the duty of the State to prevent disease, something more was needed; namely, a knowledge on the part of the health officers of the approach of epidemics. Of course, this want implied the existence of health officers, whose duty it should be to take measures to stop an epidemic, and who should have the power to carry out proper measures for so doing.

This need has indeed been recognized for many years, and in many countries; but usually the laws have referred solely to the more dangerous diseases, like small-pox, cholera, yellow fever and plague, or it has become the custom to interpret them in that way.

The late Dr. George Derby suggested at one time the value of returns from the dispensary physicians and hospitals of the diseases treated,* to be reported to the State Board of Health weekly; a method which has yielded excellent results in the army medical departments in different countries. This has indeed been done to a certain extent in England, where the medical officers of the Poor-Law Board are required to report to the health officers the cases treated by them; but it is only a partial and unsatisfactory method, because hospitals, almshouses, etc., etc., are so well protected that contagious

* Third Report of the State Board of Health, p. 13.

diseases often get thoroughly established in a community before appearing there, and for other reasons, so that numerous petitions have been sent to the English government for a more stringent law requiring registration of all cases of contagious diseases. The position of the physicians is well represented by the following extract from the report of Dr. John Whitmore, health officer of St. Marylebone for 1875. (p. 20) : "It is very certain that until the sanitary officials of the metropolis are able to obtain prompt information of every case of sickness from contagious or infectious diseases occurring in their respective parishes or districts, and are able, immediately on the receipt of such information, to adopt all necessary precautions, and impose all necessary restrictions, to prevent its spread or diffusion among the healthy, there will be no material diminution in the death-rate from diseases of this class."

The same is well expressed by another authority : "The choice must be between an abandonment of any attempt to register sickness, and a scheme which, by the aid of compulsory legislation, shall provide a registration of sickness which shall be of real use to the state and the community at large." *

A striking illustration of the fact that registration of diseases often secures results of importance which cannot be got from mortality returns or from physicians' impressions, has been shown in Paris during the past year, where the mortality from typhoid fever was excessive, but its prevalence not unusually great. The additional interesting facts that the disease was most prevalent in the fall, when the ground-water was low, and most fatal in the spring, correspond with the results of Dr. Pinkham in his investigations with regard to diphtheria in Lynn, and given at a later page in this Report.

In 1874 the British Medical Association appointed a committee to consider the best method of accomplishing this object, and they reported, in 1876, that the families and friends of the sick should be required by law to give information of all cases. In some few places in England physicians have volunteered to report to the health officers at once their cases of contagious diseases. In Newcastle-upon-Tyne "daily

* Sanitary Record, March 4, 1876.

notice continues to be received, from the dispensary and other sources, of infectious diseases of all kinds, when, as hitherto, examination into its probable cause is at once proceeded with, and such recommendations and steps taken as are most suited to the nature of the case and best conduce to the extinction of the disease, including the gratuitous disinfection and purification of the premises of cases and the replacing of infected articles of bedding by others." *

Holland.

In what has actually been done by the state, the Netherlands are far in advance of the rest of the world. By the law of December 4, 1872, the following regulations (among others) were made relative to contagious and infectious diseases (small-pox and varioloid, scarlet fever, measles, typhus fever, typhoid fever, cholera and diphtheria, to which dysentery was added December 3, 1874) :†—

Burgomasters may remove patients from tenement houses and taverns to a hospital, if they deem it necessary, and by advice of a physician.

They may temporarily close such public houses, etc., at the public expense, when the medical inspectors deem it necessary.‡

They may cleanse and disinfect houses, cottages, and vessels, upon the order of one of the inspectors or of a practising physician.

They may, with medical authority, disinfect or destroy articles infected or suspected to be so.

They may remove filth, cleanse streets, etc., etc., in preparation for a threatened epidemic.

They may regulate, in various ways, the transportation of such sick persons, the attendance at school of children, and the discharge from the hospitals of those sent there.

Neither teachers nor scholars are allowed to enter schools, who have not been vaccinated or have not had small-pox.

In each district the authorities must furnish opportunity for free vaccination at least once in every three months.

They must provide proper places for the treatment of contagious diseases, when required by general order to do so.

They must provide dead-houses within a year after the passage of the law.

* Report of the medical officer of health on the sanitary condition of Newcastle-upon-Tyne during the year 1875, by Henry E. Armstrong, M. R. C. S., 1876.

† If deemed necessary, other diseases may be added to this list by the authorities for the time being; but permanent additions must be made by royal statute.

‡ By the law of June, 1865, there are seven inspectors in the kingdom, of whom each has a separate district. Five of these inspectors, having large districts, have assistants.

In case of death from contagious or infectious disease, they may send the corpse at once to the dead-house.

Heads of houses, masters of vessels, etc., must report all cases of the above-mentioned diseases to the burgomaster, under penalty, within twenty-four hours.

Doctors must report all cases of cholera and small-pox to the burgomaster, under penalty, within twenty-four hours.

The houses in which there are contagious diseases must be conspicuously marked by the officials with the words "*Contagious Diseases*," and with the name of the disease.

Public announcement of epidemics in any district must be made, and weekly reports of cases and deaths from all of the above diseases, except measles, must be published by the burgomaster; from measles, only the deaths.

In case of cholera, there must be daily reports.

Public fairs and festivals may be stopped on account of the presence of an epidemic.

Medical inspectors have power to enter houses where there are contagious diseases.

The penalties for violating the various provisions of this law are fines from five to one hundred florins, and imprisonment from three days to a month.

According to Dr. Egeling, the medical inspector of South Holland, excellent results have been got by this law, and he gives a list of the persons who were fined in 1874 for violation of it.* In many places it has been well enforced; but in the report of the department of works at Rotterdam,† the ratio of deaths reported to the cases reported indicates that the law was not in all cases carried out.

Germany.

In Germany, an advisory board of health for the empire was appointed last summer, with Dr. Struck as chief medical officer. Their first work was to undertake to revise the sanitary statutes, especially with relation to vital statistics; and a commission had already reported favorably to the parliament on a law regarding registration of contagious and infectious diseases, as had been suggested by the German Public Health Association in 1875. In Prussia, already, every town of over 5,000 inhabitants must have a *sanitäts-commission*, who have large powers in the police of infectious diseases.

* Verslag aan den Koning, etc., 1875 (pp. 248 *et seq.*).

† Verslag van den Toestand der Gemeente Rotterdam, 1875 (pp. 105 *et seq.* and Appendix F.).

United States.

In the United States, the board of health of Brooklyn began, May 1873, to require physicians to report all cases of contagious diseases, as the sanitary code provided, including especially cholera, yellow fever, small-pox, scarlet fever, cerebro-spinal meningitis, typhus fever, typhoid fever, diphtheria, and "any other disease publicly declared by the board of health dangerous to public health." In their last report they say (page 11), "the report of transmissible diseases by physicians has been insisted on and enforced by the board," and (page 12) "whenever it is found that there has been a failure to report, the matter is investigated, and, if not properly explained, is referred to the attorney of the board for prosecution."

The number of cases reported from May, 1873, to January, 1875, was 2,007; during 1874, 4,637; and Dr. Hutchison, the health commissioner, says that under this ordinance the mortality for 1874 was 3.56 per cent. less than for previous years. "The decrease in the mortality was principally of the diseases termed 'infectious,' and with the causes of which it is the duty of sanitary authorities to contend."

Many of the regulations of the board show great care; for instance, "funerals after deaths from small-pox must be conducted without delay, and these also are superintended by an officer of the board."

The total number of actions commenced by the attorney of the board, on all cases, from September, 1873, to January, 1875, was 1,288.

All physicians possessing diplomas from medical schools are registered by the board, and all deaths not certified by them are investigated by the proper officers.

In Pittsburgh, similar work was done in 1875, and the health officer, Dr. Crosby Gray, reports that "the law is not as effective as it should be, as it fails to mention specifically some of the diseases which are regarded as infectious, and a few of our physicians are inclined to take advantage of the defect. However, a majority do comply, and all, I believe, report small-pox."

In Oakland, California, "Dr. C. S. Kittredge was elected

registrar, to collect statistics to enable the health department to ascertain, as nearly as possible, the exact number of cases of sickness for each death occurring during any given period, properly classified. The value of such statistics, when accurately collected, and sufficiently large, is well recognized. Unfortunately, after some 1,200 cases had been collected, the returns, even after repeated appeals for continuance were made, ceased almost entirely to be made, so that there was no possibility of the continuance of this 'labor of love.' " *

During the year 1875, Dr. F. W. Draper ably carried out, under the authority of the Massachusetts State Board of Health, a plan of reporting prevalent diseases suggested by him. As nearly as can now be said, about one hundred and ten physicians, a little more than one-half the number who agreed to coöperate, sent in their reports each week from about ninety of the three hundred and forty-one cities and towns in the State. Unfortunately, too, for comparison, the physicians not reporting were not the same from week to week.

According to the last census there are 2,345 male physicians and 91 female physicians in the State, with a population of 1,651,912; and the Board therefore received one weekly report to represent 15,000 people, and from less than one physician in twenty. It was hoped that some method might be reached whereby a sufficient number of returns might be got each week to allow the generalizations from them to be based upon more complete and fuller knowledge; but, even allowing one return from an average of 3,000 people, the expense would be very much greater than the present appropriation of the Board would justify. There was the fact, too, that the information got would be general opinions and not positive facts, and, although they would have some local value, any trustworthy generalizations from them would be attended with such difficulty and must be so limited as to make their value somewhat questionable.

The state board of health of Michigan have modified and are testing this experiment still further; but for the present, the Massachusetts Board are publishing, each week, in the "Boston Daily Journal," the death-rates, etc., from cities and

* Report of the Board of Health of Oakland, 1876, p. 5.

towns representing about one-half the population of the State, of which a copy is given :—

"MORTALITY IN MASSACHUSETTS.

"Deaths reported in Seventeen Cities and Towns for the Week ending November 4, 1876.

CITIES.	Estimated Popu- lation.	No. of Deaths in each.	Annual Death- rate per 1,000, during week.	Death-rate from principal Zymo- tic Diseases.
Boston,	352,000	131	19.64	3.84
Worcester,	51,300	22	22.30	10.14
Lowell,	51,700	33	33.19	16.09
Chelsea,	21,300	9	21.97	4.88
Cambridge,	50,000	7	7.28	1.04
Salem,	26,500	13	25.51	9.81
Lawrence,	36,000	10	14.44	4.33
Springfield,	81,400	9	14.90	8.27
Lynn,	34,000	14	21.41	6.11
Gloucester,	17,000	7	21.41	15.29
Fitchburg,	12,600	4	16.51	12.3
Taunton,	20,700	4	10.05	2.5
Newburyport,	13,400	6	23.28	7.45
Fall River,	47,200	15	16.53	4.41
Haverhill,	15,000	3	10.04	—
Holyoke,	17,300	6	18.03	6.01
Pittsfield,	12,500	5	20.80	4.16
Total,	809,900	298	19.18	5.78

"Deaths from prevalent diseases in the seventeen cities and towns :—

Diphtheria and croup, thirteen cities and towns,	56
Consumption, twelve cities and towns,	55
Pneumonia, seven cities and towns,	17
Typhoid fever, seven cities and towns,	11
Scarlet fever, three cities and towns,	6

"The mortality from consumption and pneumonia remains very nearly as for the week previous. Diphtheria and croup and scarlet fever have slightly increased. Typhoid fever and the diarrhoeal diseases have decreased. No deaths are reported from small-pox; but there is one case in Holyoke (non-fatal).

"CHAS. F. FOLSOM, M. D.

"Secretary of the State Board of Health."

This is not, by any means, as satisfactory as the Board would desire; for it fails to include all the deaths in all the

cities reporting, allows many local and non-fatal epidemics to escape being reported, and undoubtedly in some of the cities gives a certain number of erroneous causes of death ; but it is the least incomplete practical method at present, improves from year to year, and, at least, cannot seriously mislead.

That there should be something more than this is evidently desirable ; and it is to be hoped that the means of informing the community promptly, with regard to the appearance of contagious diseases, may be one of the near possibilities.

THE GROWTH OF CHILDREN.

BY H. P. BOWDITCH, M. D.,
PROFESSOR OF PHYSIOLOGY, HARVARD MEDICAL SCHOOL.

THE GROWTH OF CHILDREN.*

On the 24th of September, 1872, at a meeting of the Boston Society of Medical Sciences, a communication was made of which the following report was published in the "Boston Medical and Surgical Journal" for December 19, 1872:—

"Dr. Bowditch exhibited a diagram showing the rate of growth, in height, in the two sexes. The curves of growth were so drawn that the abscissas gave the age in years, and the ordinates the height in feet and inches. They represented the average measurements on thirteen individuals of the female and twelve of the male sex. The measurements were all taken annually during the last twenty-five years, and the individuals were all nearly related to each other. An examination of the curves shows the following facts:—

"1. Growth is most rapid during the earliest years of life.

"2. During the first twelve years boys are from one to two inches taller than girls of the same age.

"3. At about twelve and a half years of age girls begin to grow faster than boys, and, during the fourteenth year, are about one inch taller than boys of the same age.

"4. At fourteen and a half years of age boys again become the taller, girls having, at this period, very nearly completed their growth, while boys continue to grow rapidly till nineteen years of age.

"The tables and curves of growth, given by Quetelet, show that, in Belgium, girls are, at no period of their lives, taller than boys of the same age, though at twelve years of age their weight is precisely the same as that of boys, and decidedly less both before and

* The investigation, of which the results are given in this Report, was originally undertaken under the auspices of the health department of the Social Science Association, but in view of the extended character which the inquiry gradually assumed in its progress, and of the direct bearing of the question on the sanitary condition of the people, it was decided to make it the subject of a report to the State Board of Health.

after that period. Measurements taken among the lower classes, in Manchester and Stockport, show that, during the thirteenth and fourteenth years, girls are superior to boys of the same age, both in height and weight.

“It would be interesting to determine, by more extended observations, in what races and under what climatic conditions the growth of girls, at about the period of puberty, is the most rapid. It is possible that in this way, facts may be discovered bearing upon the alleged inferiority in physique of American women.”

To explain the discrepancy thus apparent in the results of observations in different countries, a renewed investigation seemed to be necessary, and, as a contribution to our knowledge of the subject, a systematic measurement of the pupils, in the public schools of Boston, was undertaken.*

The nature and object of the inquiry are explained in the following letter read by Dr. D. F. Lincoln at the meeting of the Social Science Association at Detroit, in 1875, with the hope of exciting an interest in the subject, which might lead to similar investigations in other parts of the country.

“The object of ascertaining the heights and weights of the pupils in the public schools of Boston is to determine the rate of growth of the human race under the conditions which Boston presents. It is, of course, very desirable that similar observations should be made in other parts of the country, in order to enlarge the number of data from which conclusions may be drawn. This country offers an excellent field for investigations of this sort, not only on account of the wide range of climatic conditions which it presents, but from the fact that the inhabitants are the immediate descendants of a large number of different races. If we can compare, therefore, the rate of growth of a race in their native land, with the rate of growth of the same race after emigration to this country, we shall be able to study the effect of transplantation into new climatic conditions; and if we compare together the amount of change which the rate of growth of different races undergoes after emigration to this country,

* The necessary authority for the work was granted by the school committee in the following order:—

IN SCHOOL COMMITTEE, March 9, 1875.

Ordered, That permission be given to Prof. Henry P. Bowditch, of Harvard University, to ascertain the height and weight of the pupils attending the public schools, through such an arrangement as the respective chairmen and the head masters, or masters, may deem most convenient.

Attest: BERNARD CAPEN, *Secretary*.

we shall have data for estimating the relative adaptability of the races in question to the new climate. Moreover, if it shall be found that the rate of growth of the female sex is more seriously modified by emigration than that of the male sex, light may be thrown on the question of the cause of the alleged inferiority of the physique of American women. As the value of observations of this sort depends entirely upon their accuracy, it is important that the height should be measured without shoes, on rods graduated to one-tenth of an inch. The weight should be determined on scales weighing pounds and ounces.

METHOD OF INVESTIGATION.

In order to obtain the necessary data, blanks, with the following headings, were prepared and distributed to the various schools :—

*Record of the Height and Weight of the Pupils in the
School for , Boston, 187 .*

Number.	NAME.	AGE.		HEIGHT WITHOUT SHOES.		WEIGHT IN ORDINARY CLOTHES.		Birthplace.	NATIONALITY OF PARENTS.		Occupation of Parents.	Remarks.
		Years.	Months.	Inches.	Tenths.	Pounds.	Ounces.		Father.	Mother.		

The principals of the schools were personally visited, the nature of the inquiry explained to them, and their coöperation in the work requested. It is to the friendly and intelligent interest shown by these gentlemen that the success of the work is in great measure to be attributed. The above-mentioned blanks were filled out by the various teachers for their respective classes, the weighing and measuring being done under the personal superintendence of the principals themselves, or, in a few instances, under that of a trustworthy deputy. The heights, without shoes, were measured by means of a rod graduated to tenths of an inch and furnished with a sliding horizontal bar and a clamp by which it could be fixed firmly to any table in a vertical position. The heights were usually recorded at the nearest tenth of an inch, but in some instances at the nearest quarter inch. In the case of

one set of papers, where they were given at the nearest inch, the observations were rejected in calculating the averages.

The weights were determined by Fairbanks' platform scales weighing to ounces; but, in view of the error necessarily introduced by the unknown weight of the clothing, they were recorded only at the nearest quarter pound. The allowance to be made for clothing in calculating the average net weight will be considered later.*

The birthplace of the pupils was recorded with the view of discriminating between native- and foreign-born children, but the latter were found to be so few in number, that it was thought best to disregard entirely the data of this column.

The nationality (*i. e.*, the native country) of the parents was ascertained by questioning the pupils. In a few instances, where, owing to the youth or ignorance of the pupils, the result of this inquiry was unsatisfactory, the necessary information was obtained through the police. It is not to be supposed that the data recorded under this heading are absolutely accurate. There are doubtless instances where foreign-born parents are recorded as American; but this probably occurs chiefly in those instances where the parents have emigrated to this country in very early life, and have thus become completely acclimated before the birth of their children. For a thorough study of the effect of climate in modifying the rate of growth of different races, it would, of course, be important to ascertain the nationality of the ancestors of the pupils for several generations; but this inquiry seemed quite impracticable for the generality of public-school pupils, and was therefore not attempted. Data of this sort were, however, obtained, through the kindness of Lieut. Zalinsky, from a number of the pupils in the Massachusetts Institute of Technology.

The occupation of parents was copied from the school records, with a view of ascertaining approximately the effect of the social condition of the parents on the growth of the children; but the utilization of the data thus obtained has been

* Notwithstanding the many advantages of the metric system of weights and measures, it was not employed in this investigation, because it was considered that, the measurements being taken by many different individuals, greater accuracy would be secured by the use of familiar units. Moreover, the general results being expressed in comparatively few figures, can be readily calculated in the metric system, and thus made comparable with those of observations taken in Continental Europe.

necessarily postponed for the present, on account of the great addition to the labor of this investigation which it would involve.

Under the head of remarks, the teachers were requested to note any deformity of the pupils which might render it expedient to exclude their measurements from the calculation of a normal average. The fact of color was also noted under this heading, in order that negro and mulatto children might be distinguished from white children of American parents.

The statistical data above described were collected in nearly all the public schools of the city proper, in several schools in South Boston, Roxbury, Charlestown and Jamaica Plain, in the Massachusetts Institute of Technology, in Mr. J. P. Hopkinson's private Latin School, in Miss Hubbard's school for young ladies, and, through the kindness of Dr. Robert Amory, in several of the public schools of Brookline. About 24,500 observations were thus collected, a number which was considered sufficiently large to justify conclusions on the subjects to which the inquiry was directed.

On the receipt of the records from the various schools, the observations were at once tabulated according to the nationality of the parents, those of each nationality being arranged on a separate series of sheets, showing at a glance, in parallel columns, all the observations of any given age. The greater part of this work of tabulation was performed by Miss Mary P. Nichols, to whose accurate and patient labor the value of the results obtained is largely due. Mr. James Dike also rendered valuable assistance in this work.

In this tabulation, it was important to select only those nationalities which would give at each age a sufficient number of observations to justify the calculation of an average. The selection was of course at the outset to a great extent conjectural and tentative, and could be definitely made only as the work progressed. It was finally decided to limit the tabulation by nationality of parents to the following groups:—

- I. Parents, both American.
- II. Parents, both Irish.
- III. Parents, one American and one Irish.
- IV. Parents, both German.
- V. Parents, one or both English.

In the last three of these groups the observations were not sufficiently numerous to establish the rate of growth with very great precision; but the results have a certain value as approximations to the truth.

The observations thus tabulated were placed in the hands of professional accountants, by whom the average heights and weights for the different ages and nationalities were calculated both in the English and in the French systems of weights and measures. The results are given in Tables Nos. 1 and 2, at the end of this article.

It will be noticed that it has been assumed in this investigation that the rate of growth of children may be ascertained by computing at any one time the average height and weight of children of different ages, as well as by determining the average height and weight of a given set of children in successive years. This assumption is doubtless perfectly justifiable, though certain theoretical objections may be urged against it. It may be said, for instance, to involve the further assumption of the prevalence at any given time of equally favorable conditions for the growth of children of *all* ages. It is, however, conceivable, that at a certain time, particularly favorable or unfavorable conditions for the growth of young children may prevail, while the growth of older children may be less affected. The rate of growth determined by observations taken at this time will therefore show a deviation from the normal type. This objection is deprived of whatever weight it may have by extending the observations over a considerable length of time. It is probable that when the investigation is carried on, as in the present instance, during the greater part of a year, the effect of such disturbing influences may be regarded as, to a great extent, eliminated, though a series of investigations undertaken at intervals of several years would be necessary to definitely settle the question. For a further discussion of this method of ascertaining the rate of growth, the reader is referred to the statistical investigations of Dr. B. A. Gould,* p. 115.

From the averages given in Tables Nos. 1 and 2, Table No. 3 was then computed, showing the annual increase both in

* Investigations in the Military and Anthropological Statistics of American Soldiers. By Benjamin Apthorp Gould. New York. 1869.

height and weight of children of both sexes, and of the above-mentioned parentage. In this table is also given in the columns headed "pounds per inch," a series of figures obtained by dividing the weight in pounds by the height in inches, and showing what, for want of a better word, may be called the "stoutness" of the children at different ages, etc.*

In order to obtain a more adequate idea of the growth of the children in this community than that furnished by the average heights and weights, another set of tables was computed, showing for every age the number of observations at each height and weight. Tables of this sort for children of American and of Irish parents, and for the whole number of observations irrespective of nationality, are given at the end of the article. (See Tables Nos. 4 to 15.) The observations on children of other nationalities were so few in number that it was not considered important to present them in this form. To facilitate a comparison of the distribution of the observations at different ages, a second column of figures is given under each age, showing the *percentage* of the observations occurring at any given height or weight.

A tabulation of this sort renders it possible to see at a glance the extreme range of variation of the individual observations. In the progress of the work, many cases were met with of heights and weights differing so widely from the average measurements of the age to which they belonged, as to excite a suspicion of error in the observation. In these cases application was made to the principals of the schools for a confirmation or a correction of the measurements. About forty errors were thus detected, the necessary corrections

* It will be noticed that in Tables Nos. 1 and 2 the ages are given "at the last birthday." Hence, the *average age* of the children thus grouped together will be six months greater than the age given in the tables. For instance, 5 years 6 months is the average age of the 201 boys of American parentage, whose height is 41.74 inches, and whose weight is 41.20 pounds. Now, since the figures in the columns headed annual increase, in Table No. 3, are the differences between the successive heights and weights in Tables Nos. 1 and 2, it is evident that they express the yearly growth precisely at the age given in the table. For instance, if the average height of the above-mentioned boys of 5½ years old is 41.74 inches, and that of the boys of the same parentage, one year older, is 44.10 inches, then 2.36 inches is the average annual increase in height of boys at 6 years of age. On the other hand, the figures in the columns of Table No. 3, headed pounds per inch, express (as in Tables Nos. 1 and 2) the ratio of the weight to the height of the children whose age *at last birthday* is placed opposite to them in the table.

made, and the tables of averages made more accurate than they otherwise would have been.

RESULTS.

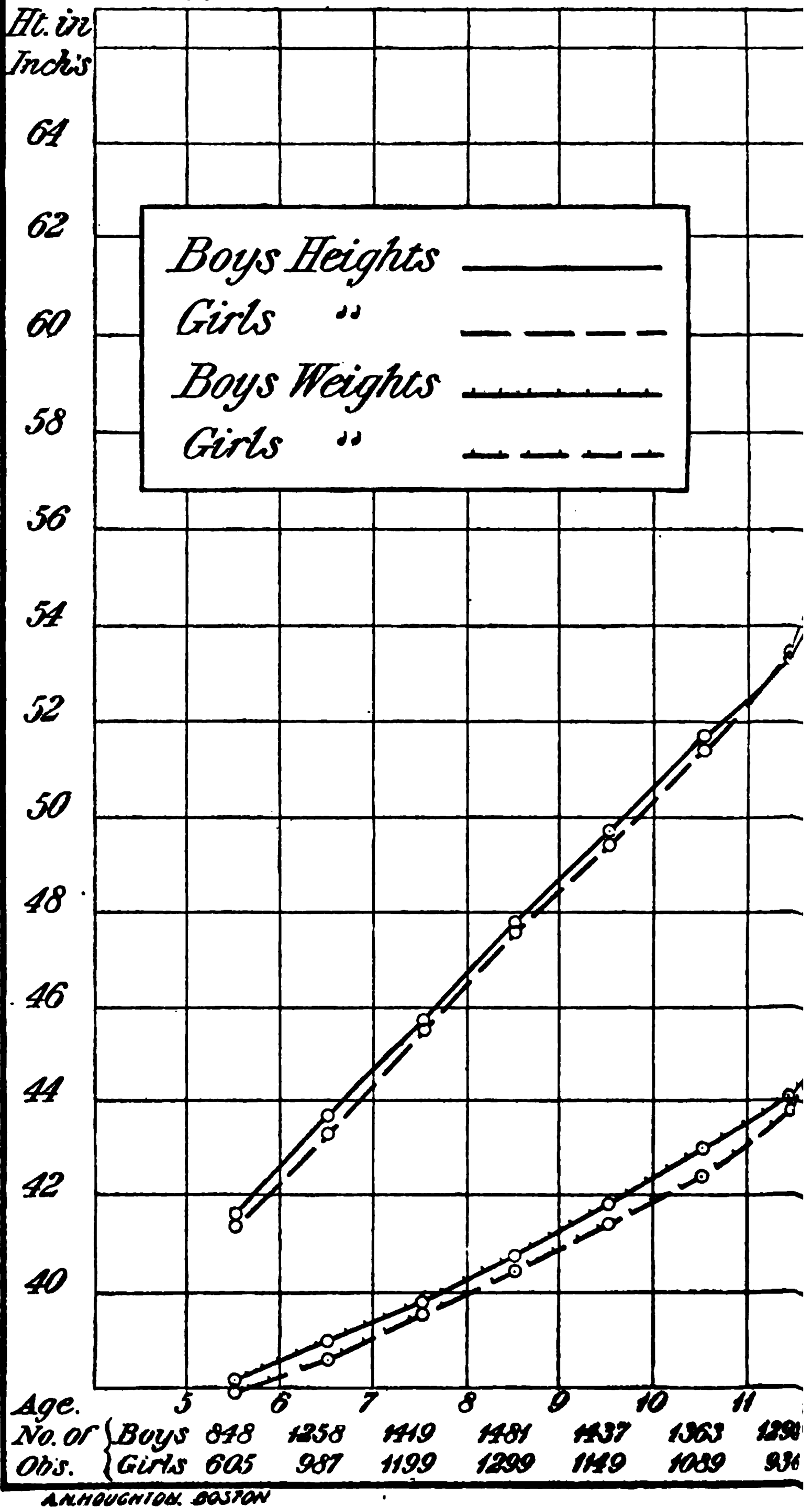
The results of the whole investigation are embodied in the tables at the end of the article ; but, in order to facilitate their comprehension, the graphic method has been adopted for their expression, curves having been constructed which indicate at a glance the more important conclusions which can be drawn from an examination of the tables. Thus, on Plate I., the ordinates of the two upper curves express the average heights for each age of all the children measured, irrespective of the nationality of their parents, the full line representing the boys' rate of growth and the broken line that of the girls. The two lower curves indicate the average weights in the same set of observations. The age is expressed by the row of figures on the line of abscissas, the height in inches by the column on the left (corresponding to the two upper curves) and the weight in pounds by the column on the right of the plate (corresponding to the two lower curves). The figures at the bottom of the plate show for each age the number of observations from which the averages were computed.

Plates II. and III. exhibit in a similar way the rate of growth in height and weight of children of American and of Irish parentage.

The curves on these plates are less regular than those of Plate I., owing to their being constructed from a smaller number of observations ; but they have the same general character. The observations on children of other than American or Irish parentage were so few in number, that it was not considered important to construct curves to express the results. An examination of the figures in Tables Nos. 1 and 2 shows that the curves of growth present everywhere the same general features.

The curves on the other plates are constructed in a similar way, and will be described in connection with the subjects which they illustrate.

Plate I. Showing rate of growth of B
Whole number of observations in
rents.



*Boston school children
respective of nationality of pa-*

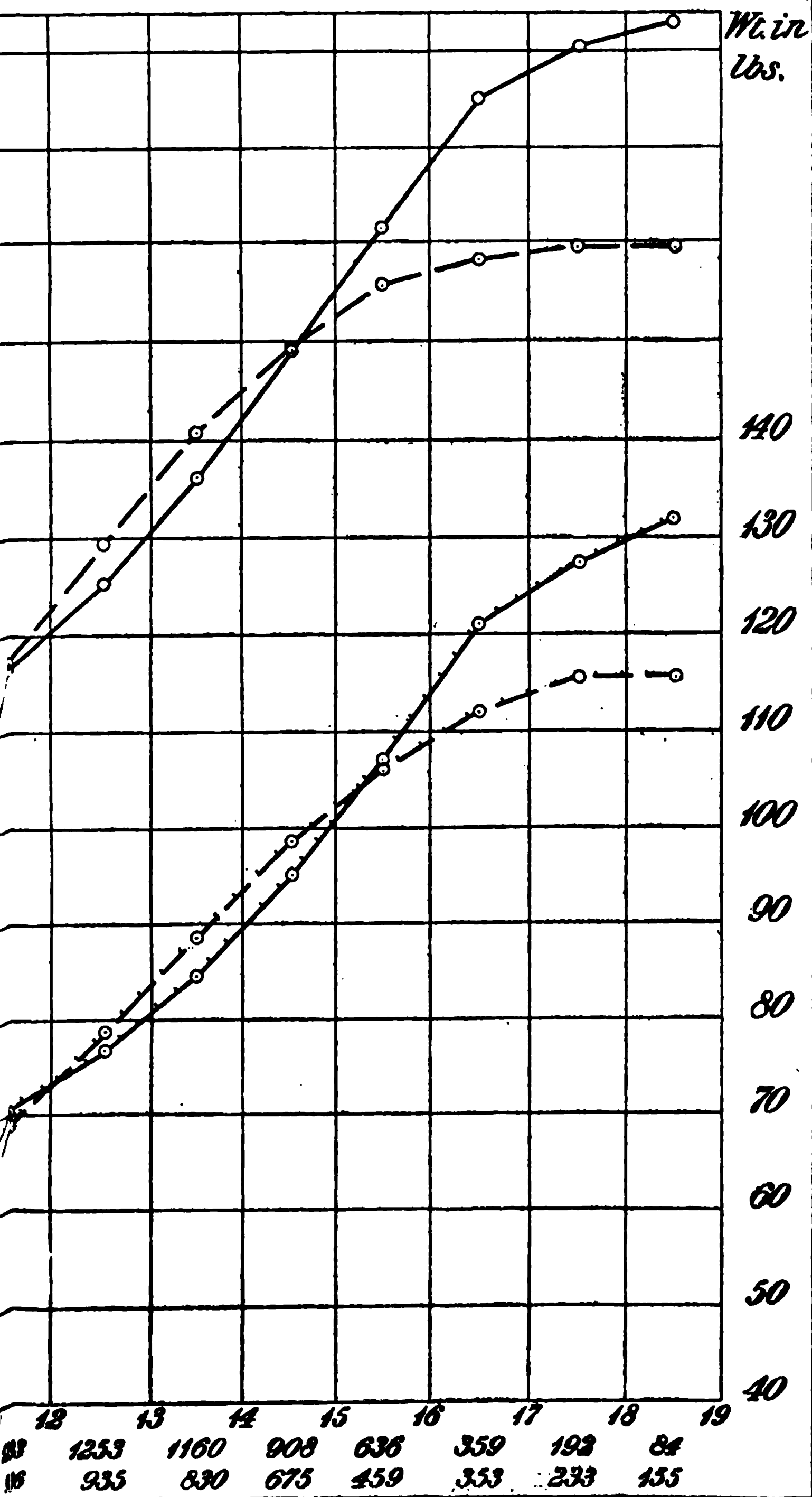
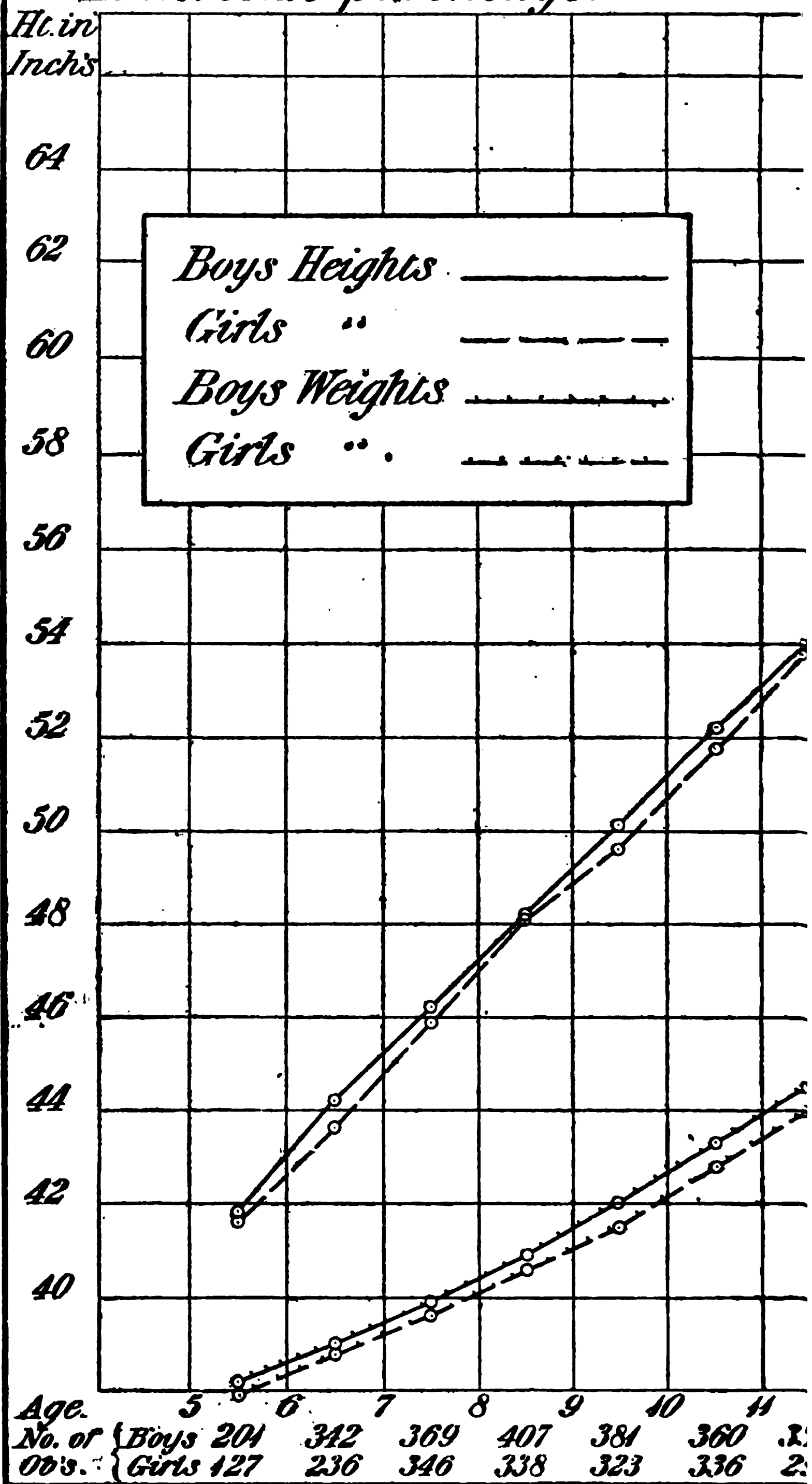


Plate II. Showing rate of growth American parentage.



of Boston school children of

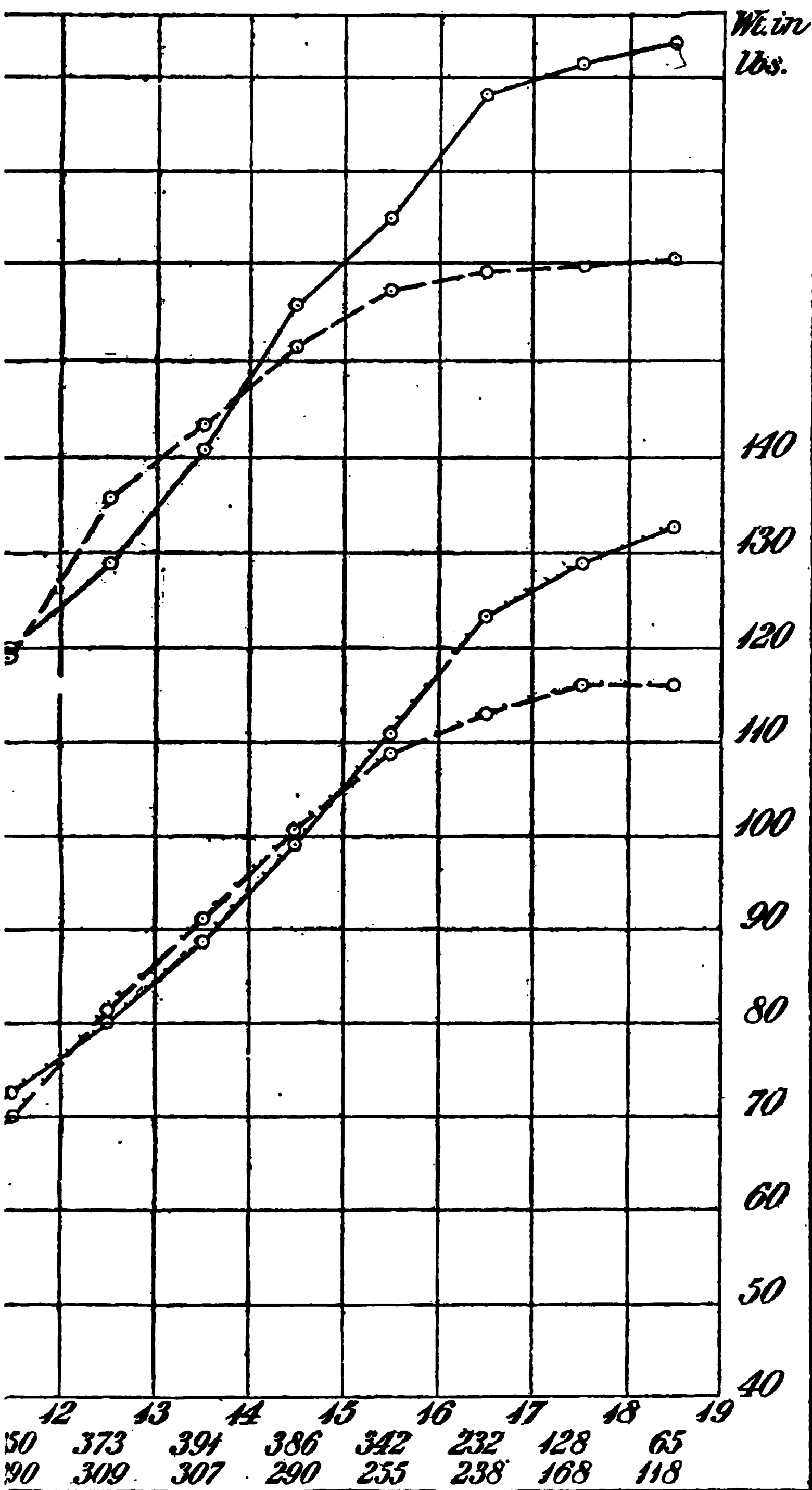
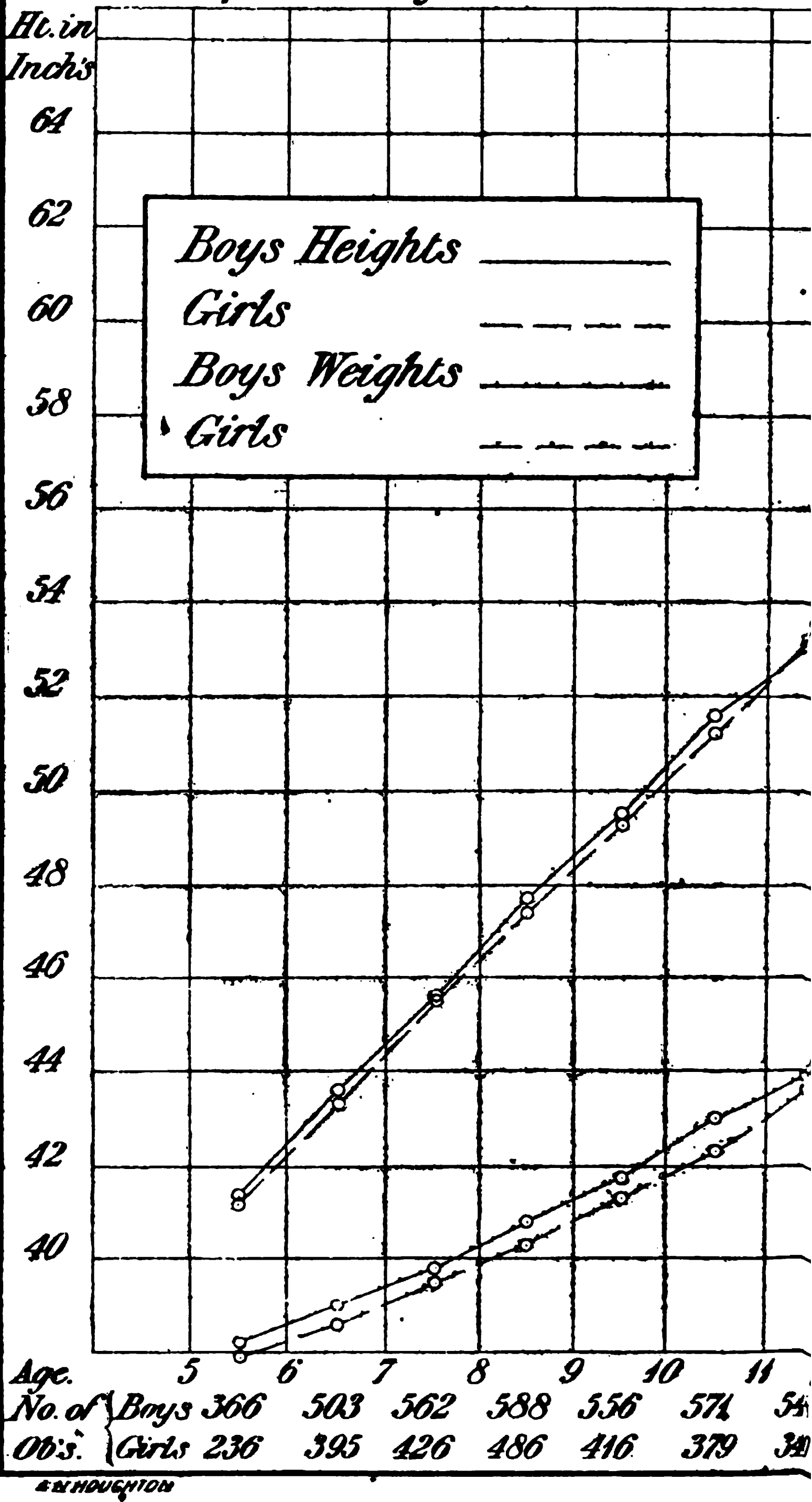
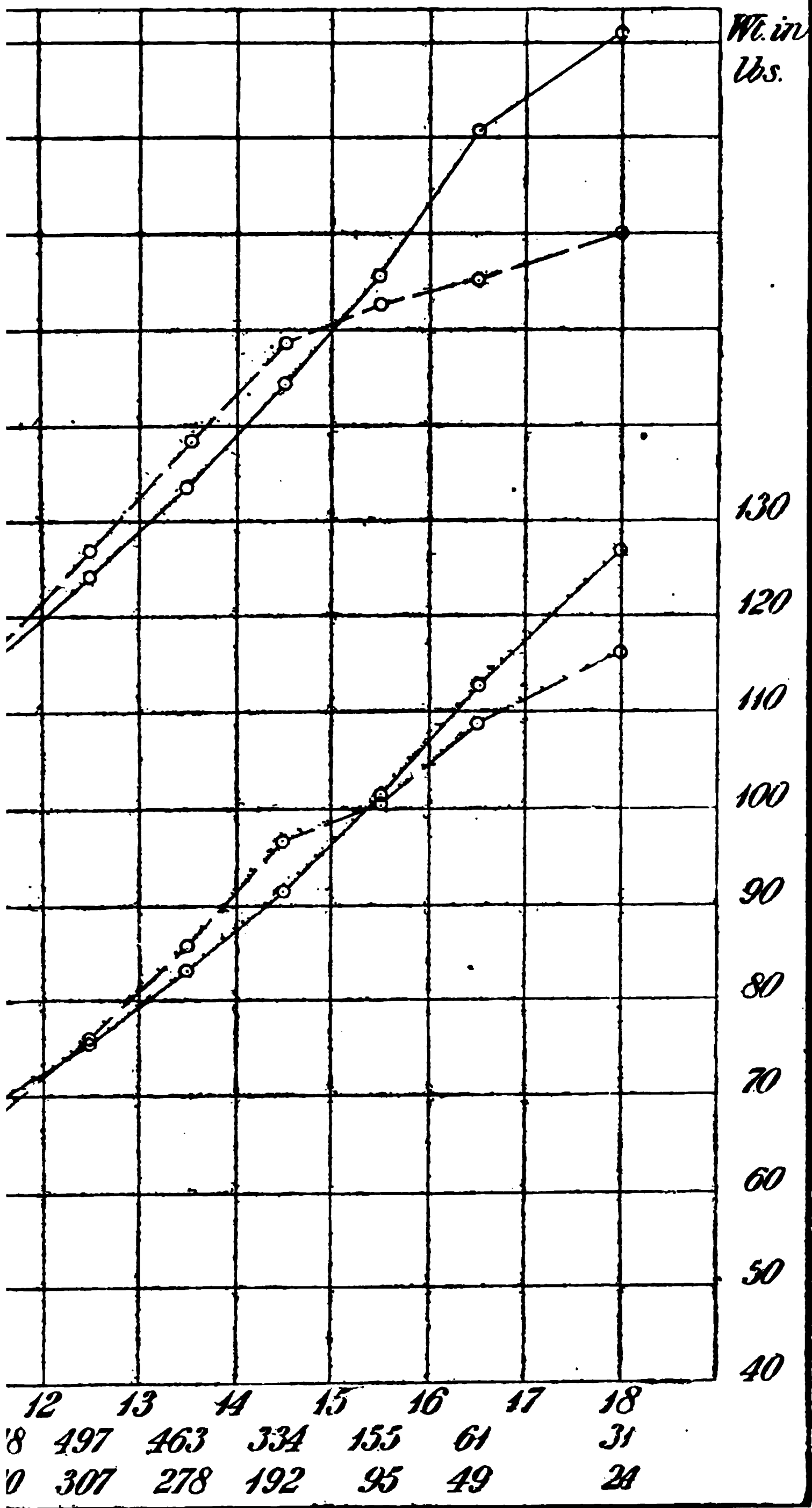


Plate III. Showing rate of growth Irish parentage.



of Boston school children of



COMPARATIVE RATE OF GROWTH OF THE TWO SEXES.

An inspection of Tables Nos. 1 and 2, or of Plates I., II., and III., shows in the most conclusive manner that at about 13 or 14 years of age girls in this community are, during more than two years, both taller and heavier than boys at the same age, though before and after that period the reverse is the case. Table No. 3, giving the annual rates of growth, shows the same thing in a different way. Here we see, in the column of totals, that the greatest annual increase in height occurs for girls at 12 and for boys at 16 years of age, while the maximum increase in weight is for boys at the same age and for girls one year later than the maximum increase in height. Similar, though not identical facts, are obtained by examination of the columns in which the observations are distributed according to the nationality of the parents.

This difference in the age at which the rate of growth attains its maximum in the two sexes, suggests a connection of the phenomenon with the period of puberty which presents a similar difference in the time of its occurrence. On the principle, clearly enunciated by Carpenter* and by Herbert Spencer,† that growth and reproduction are to some extent antagonistic processes, it may perhaps be reasonably supposed that at the age at which the organism becomes potentially reproductive will not be a period of excessive growth, and an examination of the data at our disposal seems to show that this is the case. It is of course almost impossible to determine statistically the average age at which males become capable of reproduction; but for the female sex the first appearance of the catamenia furnishes a satisfactory indication that this period has been reached. Few data have been collected for determining the age at which American women

* "There is a certain degree of antagonism between the nutritive and reproductive functions, the one being executed at the expense of the other. The reproductive apparatus derives the materials of its operations through the nutritive system, and is entirely dependent upon it for the continuance of its function. If, therefore, it be in a state of excessive activity, it will necessarily draw off from the individual fabric some portion of the aliment destined for its maintenance. It may be universally observed that, when the nutritive functions are particularly active in supporting the individual, the reproductive system is in a corresponding degree undeveloped, and *vice versa*."—*Principles of Physiology, General and Comparative*. Third edition, 1851, p. 592.

† The Principles of Biology. Vol. II., chap. 6.

begin to menstruate, but Dr. J. R. Chadwick has kindly permitted the use of his manuscript tables containing the records of observations on patients at the Boston Dispensary and the Boston City Hospital. From these records observations on 575 American-born women have been selected and arranged in the following table in such a way as to indicate whether the date of the first menstruation was given approximately or accurately.

TABLE No. 16.

Showing the Age at which Menstruation begins in American Women.

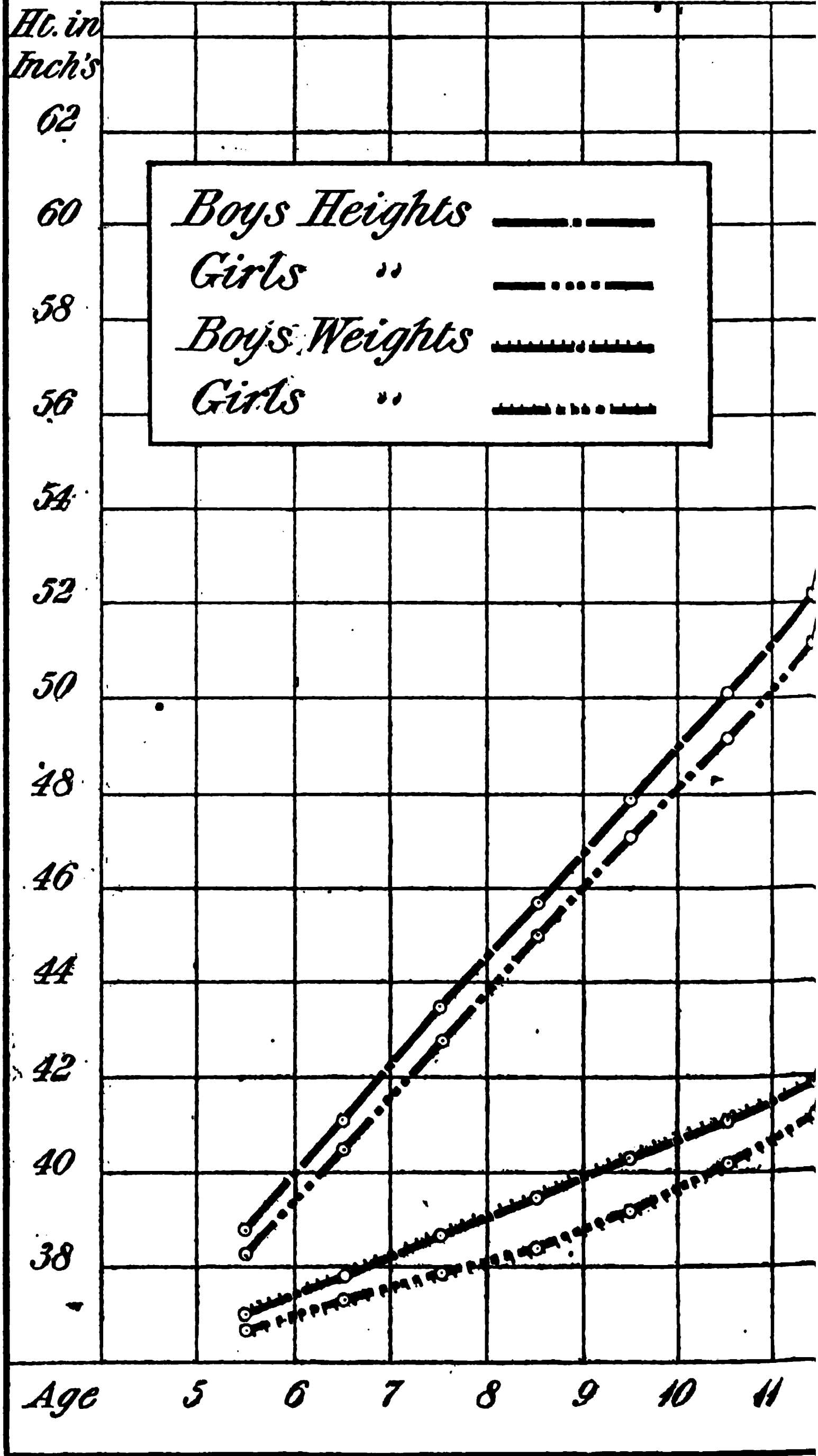
AGE AT LAST BIRTHDAY.	NUMBER OF OBSERVATIONS.		
	Approximate.	Accurate.	Total.
10,	4	—	4
11,	18	8	26
12,	44	5	49
13,	87	20	107
14,	126	16	142
15,	96	16	112
16,	72	11	83
17,	18	6	14
18,	16	4	20
19,	4	1	5
20,	3	—	3
Whole number, . . .	488	87	575
Average age, . . .	14 yrs. 5 mos.,	14 yrs. 7½ mos.,	14 yrs. 5½ mos.

A comparison of these data with the figures in Table No. 3 shows that the period of rapid growth which gives to girls their temporary superiority over boys precedes the average age of puberty by at least two years, and that at the age of puberty the annual growth in height is less than at any previous period of life. Whether a similar relation prevails in other countries and in the male sex, are questions to be settled by future investigations.

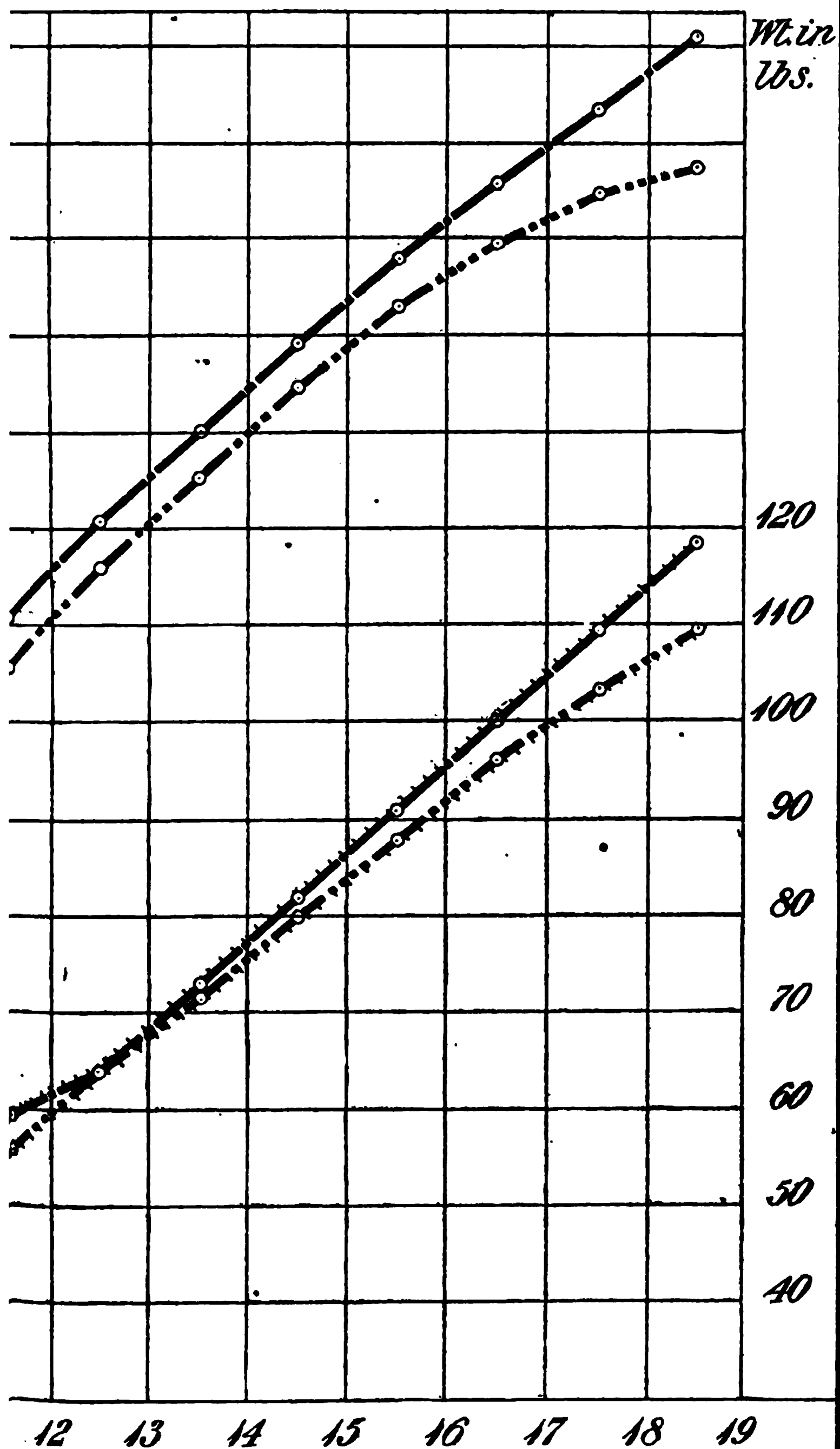
An examination of the curves on Plates I.—III. shows that the statements in regard to the rate of growth of the two sexes, made in 1872,* as the result of a very small number of observations, are fully confirmed by a more extended investigation, and that the facts announced at that time in

* See beginning of this article.

Plate IV. Showing rate of growth according to Quetelet's observations



Wt. of Belgian children ac-
tions.



regard to the growth in height are found to be equally true of the growth in weight. It was hoped at the beginning of this investigation that it would be possible, by comparing these observations with those taken in foreign countries, to determine how far the peculiarities in the rate of growth, thus made manifest, depend upon differences of race or climate. This seemed the more desirable from the fact, that, according to Quetelet, the curves of growth of the two sexes never intersect, as they are shown to do in these observations. For purposes of comparison, an extract from Quetelet's tables is here given, showing the height and weight of the children of

TABLE No. 17.

Showing Height and Weight of Belgian Children of both Sexes from 5 to 18 years of age. (Quetelet, Anthropométrie, p. 418.)

AGE.	Boys.				Girls.			
	HEIGHT.		WEIGHT.		HEIGHT.		WEIGHT.	
	Inches.	Centim.	Pounds.	Kilo.	Inches.	Centim.	Pounds.	Kilo.
5,.	38.86	98.7	35.05	15.9	38.35	97.4	33.73	15.3
6,.	41.18	104.6	39.19	17.8	40.58	103.1	36.82	16.7
7,.	43.46	110.4	43.43	19.7	42.81	108.7	39.24	17.8
8,.	45.75	116.2	47.62	21.6	44.97	114.2	41.90	19.0
9,.	47.95	121.8	51.81	23.5	47.10	119.6	46.29	21.0
10,.	50.12	127.3	55.55	25.2	49.17	124.9	50.92	23.1
11,.	52.17	132.5	59.53	27.0	51.21	130.1	56.21	25.5
12,.	54.14	137.5	63.93	29.0	53.23	135.2	63.93	29.0
13,.	56.02	142.3	72.96	33.1	55.11	140.0	71.65	32.5
14,.	57.84	146.9	81.80	37.1	56.94	144.6	80.01	36.3
15,.	59.57	151.3	90.82	41.2	58.60	148.8	88.28	40.0
16,.	61.18	155.4	100.10	45.4	59.90	152.1	95.90	43.5
17,.	62.76	159.4	109.51	49.7	60.87	154.6	103.20	46.8
18,.	64.17	163.0	118.80	53.9	61.53	156.3	109.71	49.8

both sexes in Belgium at the ages included in our observations. On Plate IV. are given curves of growth constructed from this table, by which it will be seen that the height of girls is always less than that of boys of the same age; while the weight, though the same at twelve years of age, is less both before and after that period.

Unfortunately, observations on the size of growing girls have rarely been made in any country; and it is, therefore, almost impossible to institute the desired comparison. In anthropo-

metrical investigations, the female sex seems to have been strangely neglected, though, in all questions relating to the growth and development of the race, its importance is at least equal to that of the male sex. The only accessible observations on girls, except those of Quetelet, seem to have been made in Great Britain. Quetelet himself quotes * the following observations made by Cowell among the lower classes of the population of Manchester and Stockport, by which it appears that the relative size of the two sexes varies very much, as in this community. The curves on Plate V. show the rate of growth of the factory operatives of both sexes, the values of the ordinates being taken from the above tables. It will be seen that these curves, though rather irregular, owing to the small number of observations from which they are constructed, are very different in their character from those given by Quetelet; a discrepancy to which this author, however, does not allude.

Through the kindness of Mr. C. Roberts of London, the writer has obtained manuscript tables showing the height and weight of children, of both sexes, in various classes of the community. From these records, it is evident that in England girls of 13 years of age are, as a rule, taller and heavier than boys of the same age.

It must, therefore, be assumed either that children in Belgium grow in accordance with a different law from that which is found to prevail in England and with us, or that Quetelet's tables and curves do not truly represent average heights and weights. A consideration of the method by which Quetelet's results were reached renders the latter assumption not improbable. It will be noticed that Quetelet nowhere gives the number of observations on which his average results are based. He speaks, to be sure, of his investigations having extended over a quarter of a century,† and yet he accounts for the small differences between the maximum and minimum heights for the different ages (averaging 17.6 centimeters [6.93 in.] for males, and 19.1 centimeters [7.52 in.] for females) by the statement that his observations were limited to individuals "régulièrement con-

* Sur l'Homme, II. 19 and 51; Original Observations in Parliamentary Reports, 1833, XX., D 1, p. 87.

† Anthropométrie, p. 178.

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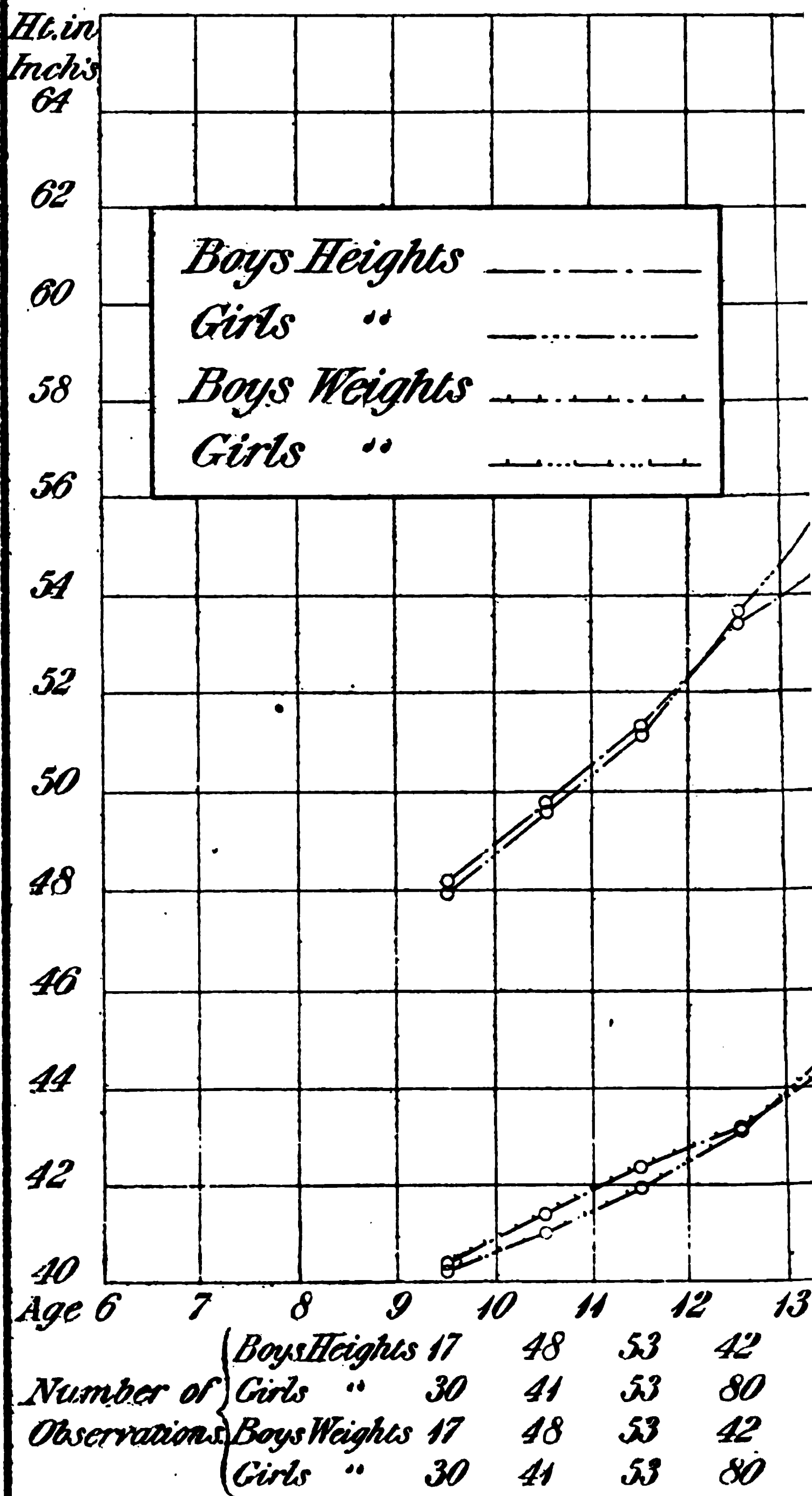
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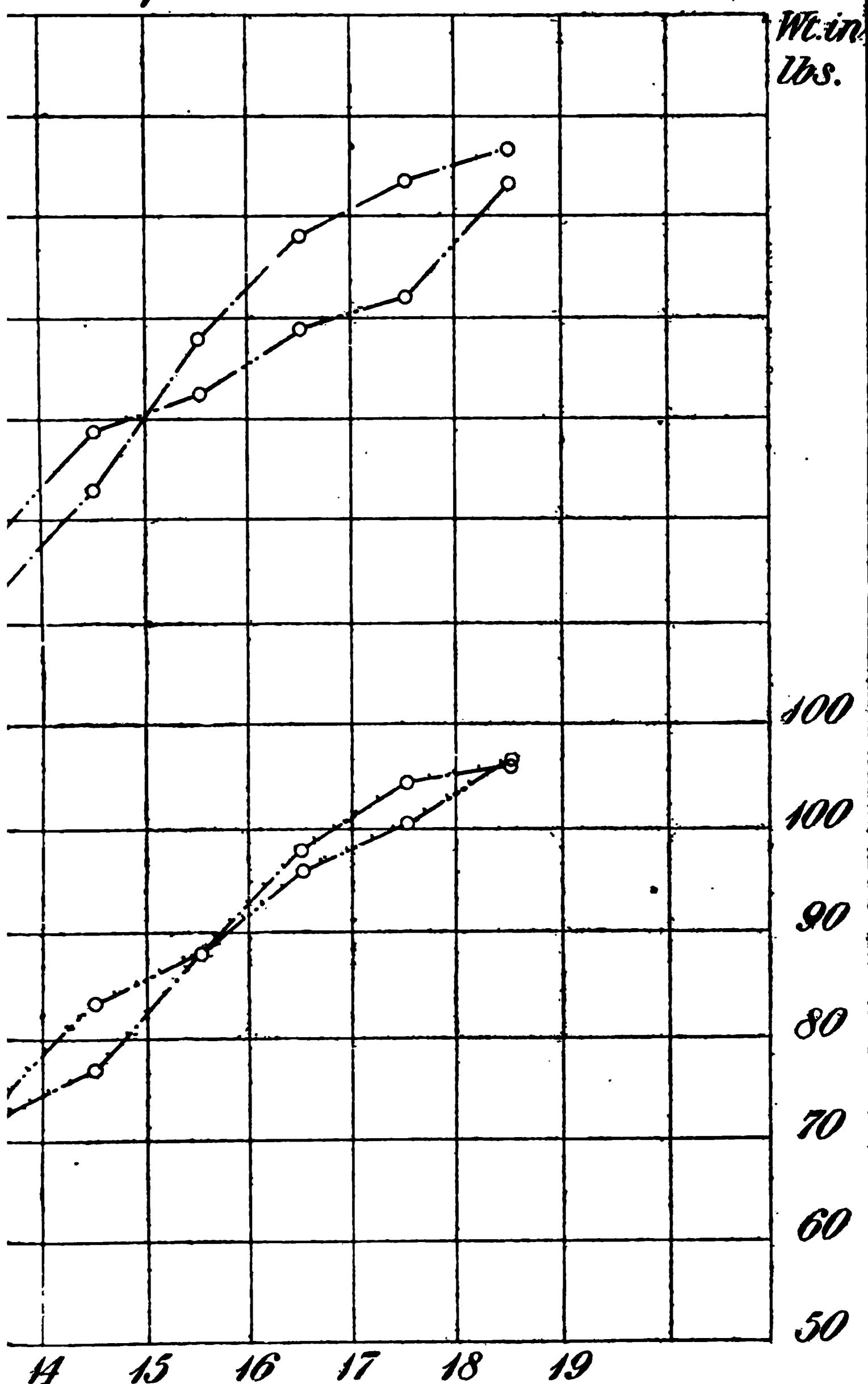
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Plate V. Showing rate of growth
in factories of Manchester and



*of English children employed
Stockport. — Cowell.*



5	51	54	52	26	22
3	81	81	83	75	65
5	61	54	52	26	22
3	80	81	83	75	65

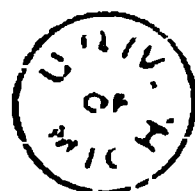


TABLE No. 18.
Showing Comparative Heights of English Boys and Girls in Manchester and Stockport. (COWELL.)

AGE.	EMPLOYED IN FACTORIES.						NOT EMPLOYED IN FACTORIES.					
	BOYS.			GIRLS.			BOYS.			GIRLS.		
	No. of Obs.	Inches.	Centl-meters.	No. of Obs.	Inches.	Centl-meters.	No. of Obs.	Inches.	Centl-meters.	No. of Obs.	Inches.	Centl-meters.
9,	17	48.139	122.2	30	47.970	121.8	41	48.564	123.3	43	48.438	123.0
10,	48	49.789	127.0	41	49.624	126.0	28	50.650	128.6	38	49.371	125.4
11,	53	51.261	130.2	53	51.155	129.9	25	51.005	129.6	29	52.099	132.3
12,	42	53.380	135.5	80	53.703	136.4	20	52.962	134.5	27	53.666	136.3
13,	45	54.477	138.3	63	55.636	141.3	22	54.977	139.6	18	55.069	139.9
14,	51	56.585	143.7	81	57.745	146.7	16	56.625	144.0	16	58.226	147.9
15,	54	59.638	151.5	81	58.503	148.6	24	58.020	147.4	13	59.153	150.2
16,	52	61.600	156.5	83	59.811	152.1	16	63.201	160.5	6	58.083	147.5
17,	26	62.673	159.2	75	60.413	153.5	20	64.068	162.7	9	60.708	154.2
18,	22	63.318	160.8	65	62.721	159.3	15	69.891	177.5	2	64.750	164.5
Totals, .	410			652			227			201		

struits," and that the number of persons subjected to measurement was "peu considérable." * In the introductory portion of the work, he describes as follows † his method of ascertaining the proportions of the human body: "I contented myself, therefore, with measuring carefully ten individuals of each age, of the male as well as of the female sex, but choosing them in general of a form which could be regarded as regular. The averages of the different groups gave me the condition of development of man from year to year." ‡ It seems, therefore, evident that Quetelet's observations were made on a comparatively small number of individuals, selected on account of their more or less close conformity to what was regarded as a normal type. No measurements seem to have been taken except on persons having a "regular form." This determination of the normal type in advance of the measurements must, of course, have been largely a matter of conjecture, and might well have led to the rejection of perfectly healthy and normal individuals whose dimensions did not correspond to a preconceived idea of the typical man or woman. It is therefore probable that if Quetelet's observations had been more numerous and less selected, it would have been found that the curves of growth of the two sexes in Belgium intersect each other much in the same way as in England and in this community.

This view derives confirmation from the admission of Quetelet, § that the growth of any one individual is far from being as regular as that indicated by the table of averages. He writes: "There are always, in the development of an individual, periods of slow as well as of rapid growth. These anomalies are to be observed about the age of puberty, and especially as the result of diseases. The perfectly normal development of all the physical faculties would require a rare combination of favorable circumstances. In dealing with a large number of individuals, these little

* Anthropométrie, p. 182.

† Anthropométrie. p. 24.

‡ As a reason for being satisfied with so small a number as ten observations, he states that on dividing the measurements made on thirty individuals into three groups of ten each, so chosen that the average heights for all three groups were about alike, he found that the other average measurements of these three groups differed from each other less than might have been expected in three successive measurements made on the same individual.

§ Anthropométrie, p. 183.

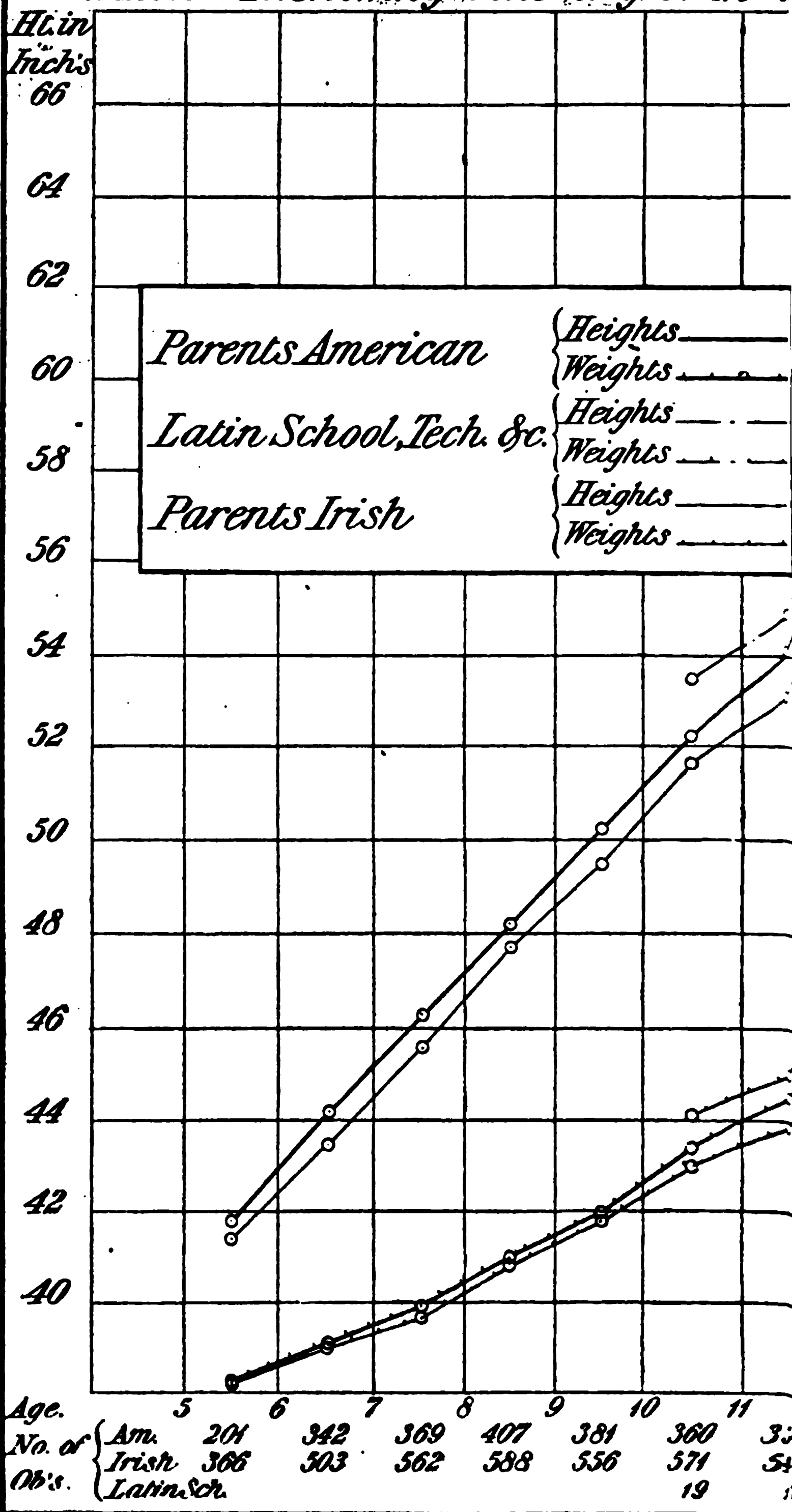
anomalies disappear in the general average, and the deficient development of one individual is balanced by the excessive growth of another; at least this is what experiment tends to teach us."

In referring to the rate of growth of a boy whose height had been annually recorded, he writes: "It will be noticed that the development was very rapid in the early years of life; then there were slight irregularities of growth between the ages of eight and fifteen years. At this latter period a rapid increase of height took place; and I have noticed the same thing in the case of my son. This increase preceded the age of puberty. Something of the same sort is to be observed in the case of girls, but here it occurs a year or two earlier. It seems, however, that there is nothing constant in the matter; hence these periods of retarded and accelerated growth balance each other to a certain extent, and leave but slight trace of their passage." It seems, therefore, that the period of rapid growth preceding the age of puberty had, in individual cases, attracted Quetelet's attention, though he found no trace of it in his tables of averages, and was inclined to regard it as a pathological result of civilization.* Inasmuch, however, as the phenomenon has in this community and in England, been found to be sufficiently constant and sufficiently marked to impress itself upon the curves representing the averages of large numbers of measurements, it seems reasonable to conclude that if similar methods of investigation (viz., measuring large numbers of individuals and rejecting none except for manifest deformity) had been adopted in Belgium, similar results would have been reached.

The curves of growth of the two sexes being recognized as so distinctly different, it is of interest to inquire what practical application can be made of the knowledge thus acquired. The first question which suggests itself is: How far should this difference in the rate of growth be allowed to modify the system of mental training to which the children of the two sexes are subjected? The physical conditions upon which the manifestation of mental activity depend are too little understood, and the whole question is too complicated to be discussed in this connection, but it seems to be almost self-

* Du Système Social, p. 24.

Plate VI. Showing rate of growth



of Boston school boys.

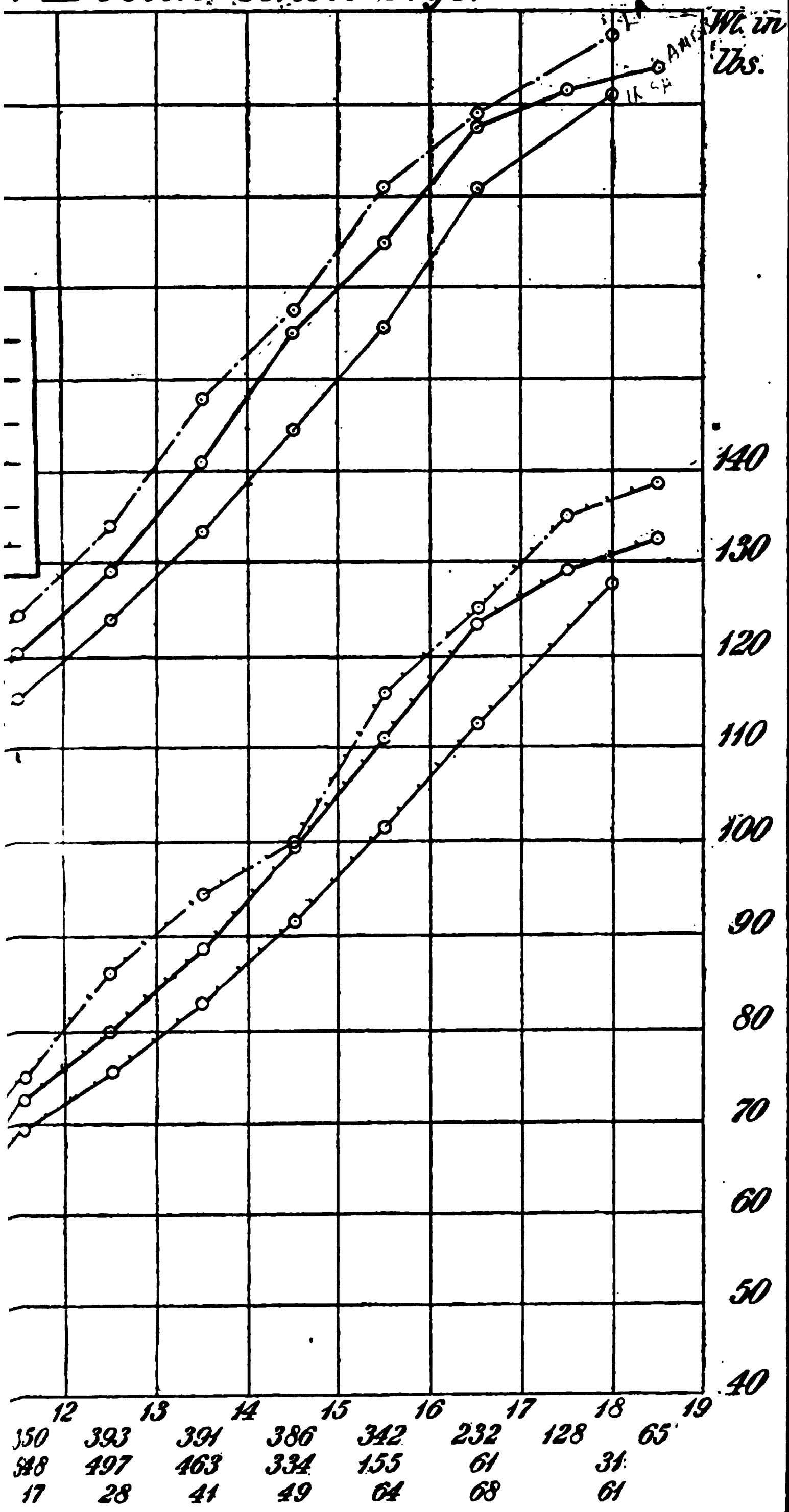
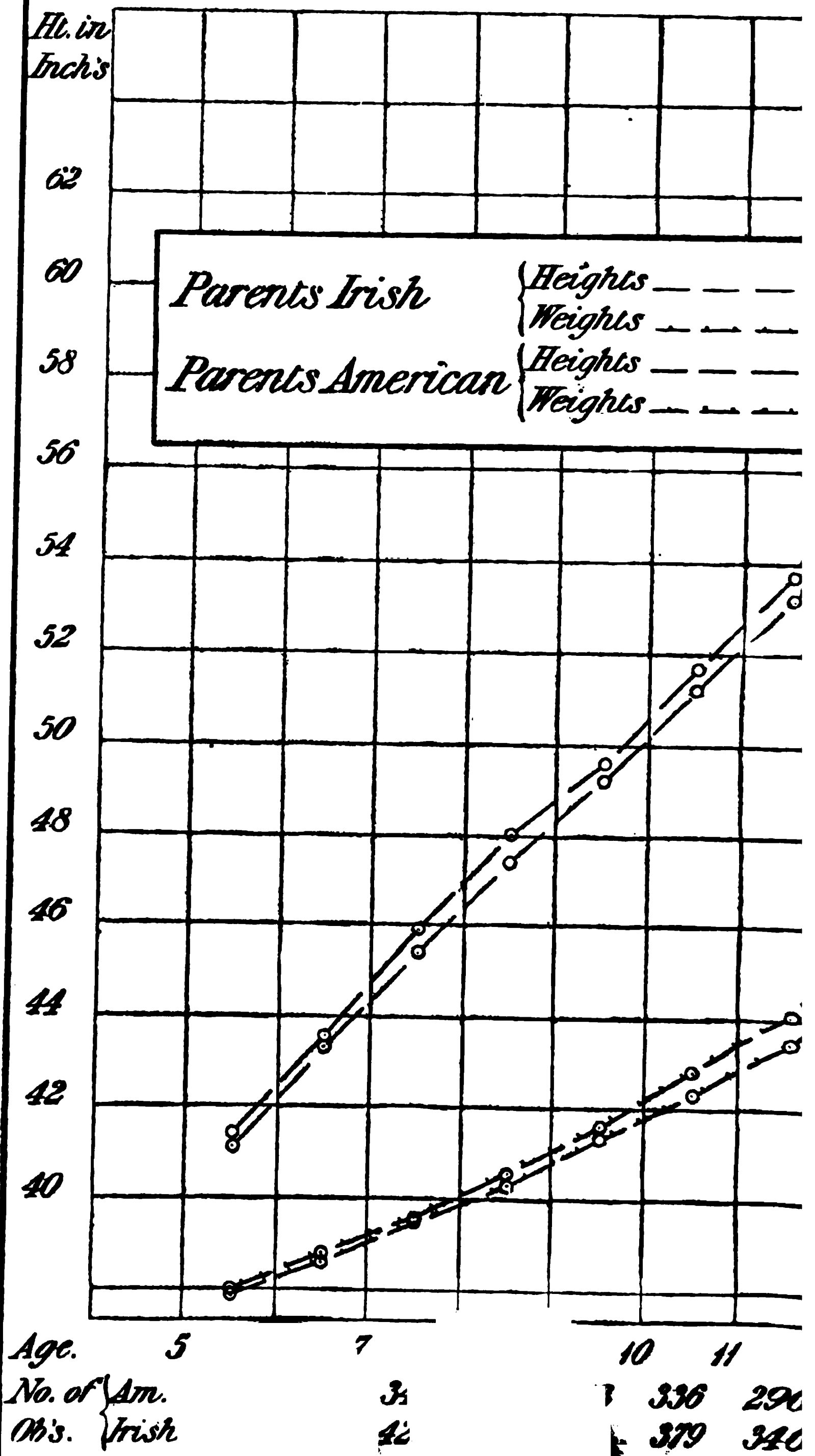
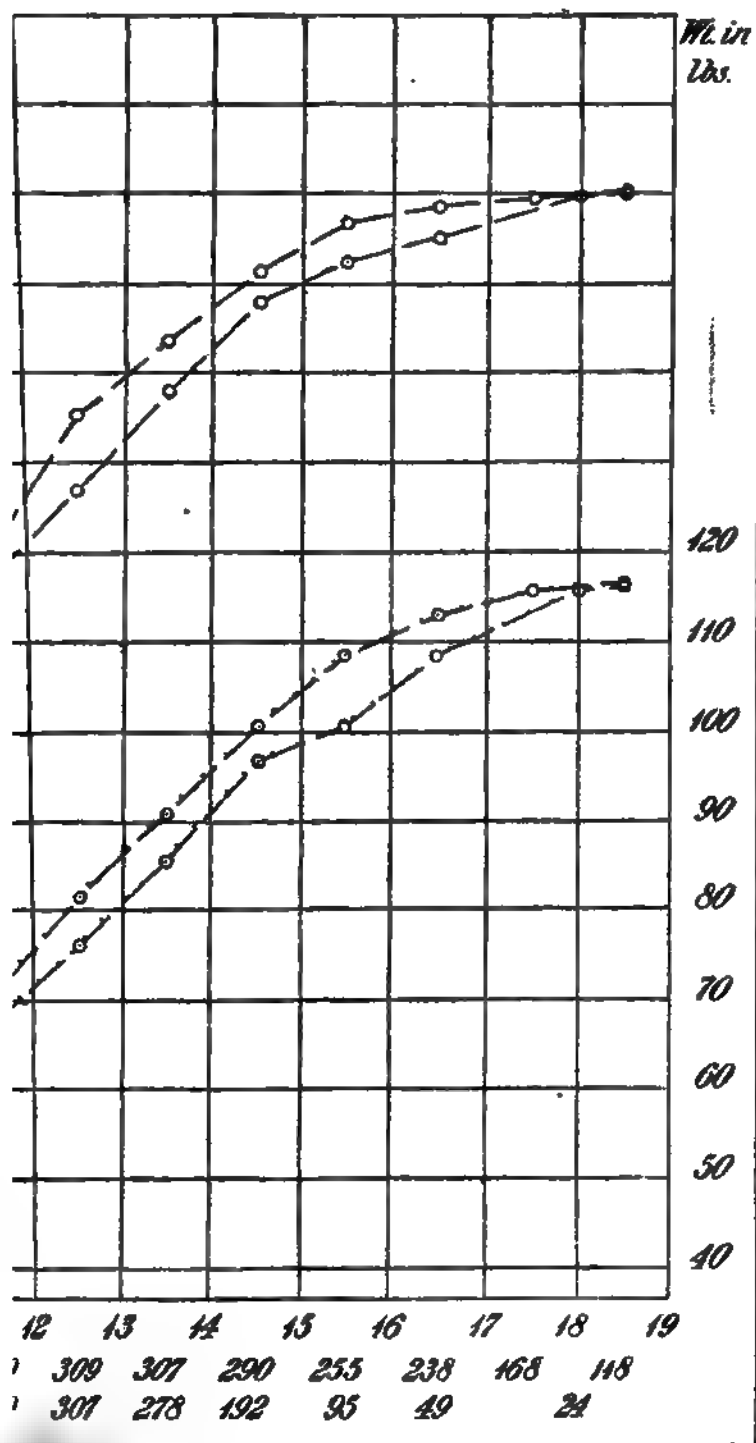


Plate VII. Showing rate of growth



of Boston school girls.



evident that at those periods when the forces of the organism are engaged in producing rapid growth and development of the physique, the requirements in the way of mental effort should be reduced. The fact that these periods occur at different ages in the two sexes, may therefore be regarded as an argument against the co-education of boys and girls, except during the earlier years of life in which rates of growth are practically the same; *i. e.*, up to ten or eleven years of age. How much importance is to be attached to this argument is a question which demands for its solution an extended series of observations on the annual growth in height and weight of a large number of individuals, taken in connection with a record of their mental progress.

EFFECT OF RACE ON SIZE AND ON RATE OF GROWTH.

An examination of Tables Nos. 1 and 2 shows that boys and girls of American parentage are, almost without exception, both taller and heavier than children of the same age and sex whose parents are of other nationalities. The curves on Plates VI. and VII. illustrate this fact for children of American and Irish parents. It has not been thought desirable to construct curves for the other nationalities, owing to the irregularities which they would necessarily present in consequence of the small number of observations.

In considering this result, the question naturally suggests itself, How far are the superior dimensions of children of American parentage dependent upon differences of race and stock, and how far are they due to other conditions accidentally associated in this community with these differences? Owing to the fact that emigrants to this country belong almost wholly to the poorer classes of the communities from which they come, it is evident that in this city children of American parents must belong to families of greater average wealth, and live, therefore, in greater comfort than children whose parents were born in foreign countries. It is important, therefore, to inquire what effect comfort and misery have upon the growth and development of the human race. Most of the investigations bearing directly upon this point have reference to the influence of these conditions on the size of the full-grown individual, and not on that of growing children.

Thus Villermé* concludes, as the result of his investigations, that "the stature is greater and the growth sooner completed, all other things being equal, in proportion as the country is richer and the comfort of its inhabitants more general." On the other hand, Boudin,† from an examination of the measurements of recruits to the army in different departments of France, arrives at the conclusion that stature is, to a great extent, "independent of comfort and misery, and is, on the contrary, closely connected with race." Villermé's results, as far as the duration of the period of growth is concerned, have also been disputed by Dr. Gould,‡ who has shown most conclusively that in the United States where "misery, in the sense of excessive poverty, affecting the supply of nutriment, physical protection from the weather and needful rest, hardly exists, the epoch of full development appears to be later than in any other country," the maximum height being attained between the thirty-first and thirty-fourth years. The effect of privations and exposure in preventing the attainment of the normal height, is, however, clearly pointed out by this writer,§ and is regarded by him as the cause of the small stature of sailors as compared with that of soldiers of the same age and state of enlistment. A similar conclusion in regard to the age at which the full stature is attained, has been reached by Dr. Baxter,|| as the result of an examination of the records of the Provost-Marshal-General's Bureau. It would, however, be manifestly unsafe to argue with this writer,¶ that "if comfort and plenty do not hasten growth, but, on the contrary, coexist with an unusually tardy and prolonged development of it, as is shown to be the case in the United States, it is fairly to be inferred that they exert little if any influence in increasing the stature"; for a prolongation of the period of growth must necessarily result in an increased stature unless the *rate* of growth is at the same time proportionately diminished, and that comfort and plenty should have the

* Quoted by Dr. Gould. Investigations in the Military and Anthropological Statistics of American Soldiers. U. S. Sanitary Commission, p. 120.

† Recueil de mémoires de Médecine, de Chirurgie et de pharmacie militaires. Paris, 1863. Vol. IX., p. 181.

‡ Loco citato.

§ Op. cit., p. 132.

|| Statistics Medical and Anthropological. Washington, 1876.

¶ Op. cit., p. 20.

latter effect is not only in itself highly improbable, but is opposed to such evidence as we have on the subject. Moreover, Dr. Baxter has himself shown* that of the 501,068 individuals, the records of whose examinations are preserved in the Provost-Marshall-General's Bureau, the natives of the United States are taller than those of any other country. He calls attention† also to the fact that natives of foreign countries enlisting in the United States have a greater average height than natives of the same countries enlisting at home. He is inclined, however, to explain this circumstance by a difference in the average age of the individuals measured; but Dr. Gould‡ has shown, that making allowance for differences of average age and of minimum limit of stature for military service, in different countries, the conclusion is unavoidable that natives of European countries who enlist in America are, on the average, taller than those who enlist at home. In searching for the causes which give to Americans, and even to persons growing up in America, though not born there, this superiority of stature, it seems not unreasonable to attribute a certain importance to the greater average comfort of the inhabitants. The prolonged period of growth in this country is certainly not to be regarded as an argument against this view, for, in the absence of any evidence of a diminished rate of growth, this may well be regarded as a result of abundant nutrition.

Statistics from which evidence can be drawn as to the effect of comfort and misery on the size of growing children are not numerous. The observations of Quetelet, Villermé, and Cowell§ seem to show that in a given community the children of the wealthier classes are, as a rule, larger than those of the poorer classes. The following table, for which I am indebted to the kindness of Mr. Roberts, throws light upon this question.

An examination of this table shows that children of the laboring classes, inhabiting towns, are, at all ages, decidedly shorter than the children of the non-laboring classes attending public schools and universities, the difference attaining a maximum of over four inches at thirteen years of age. The difference of weight is also, as a rule, decidedly in favor of

* Op. cit., p. 23.

† Op. cit., p. 180.

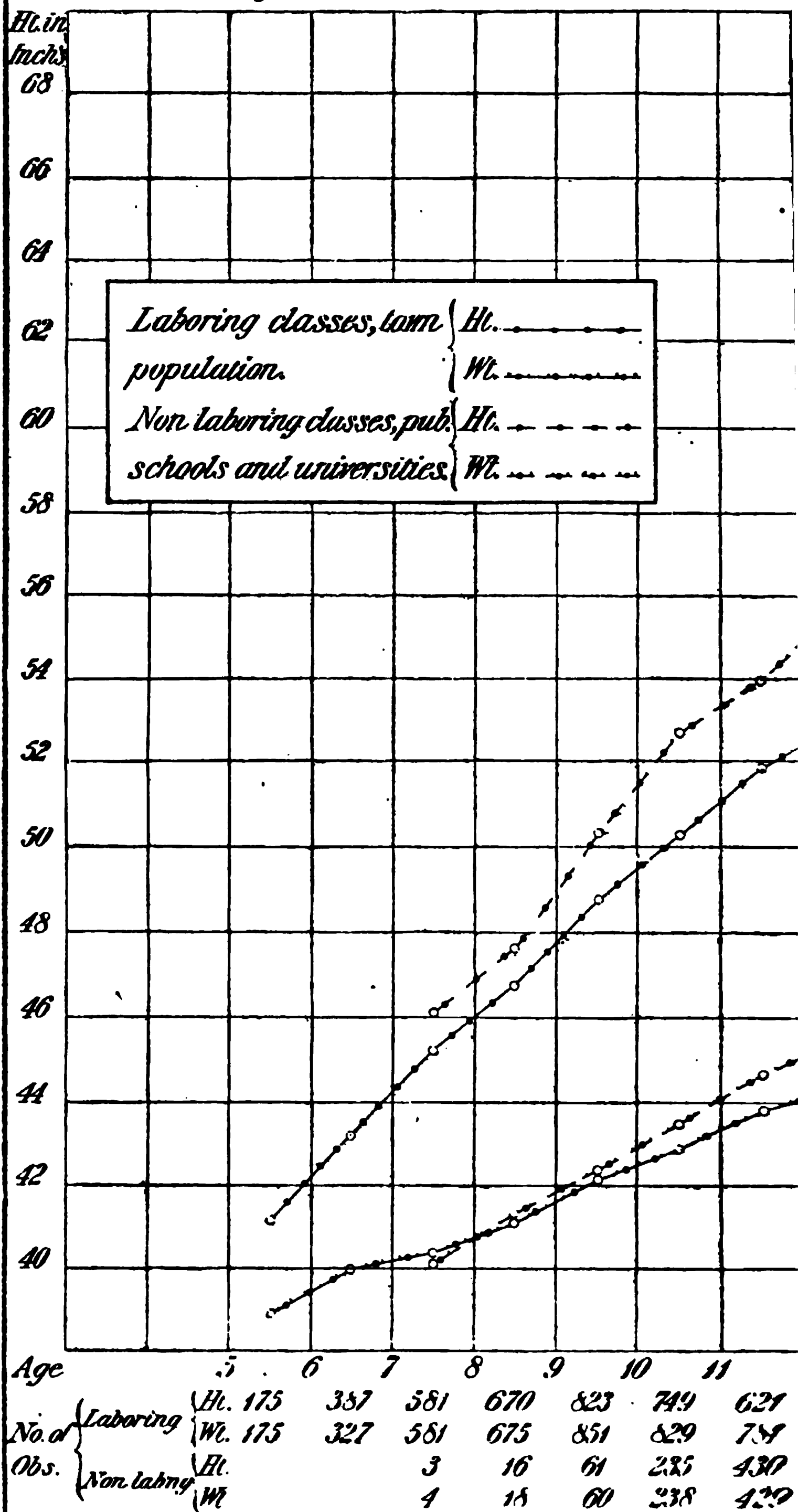
‡ Op. cit., p. 16.

§ Ludwig: Physiologie, II., 717.

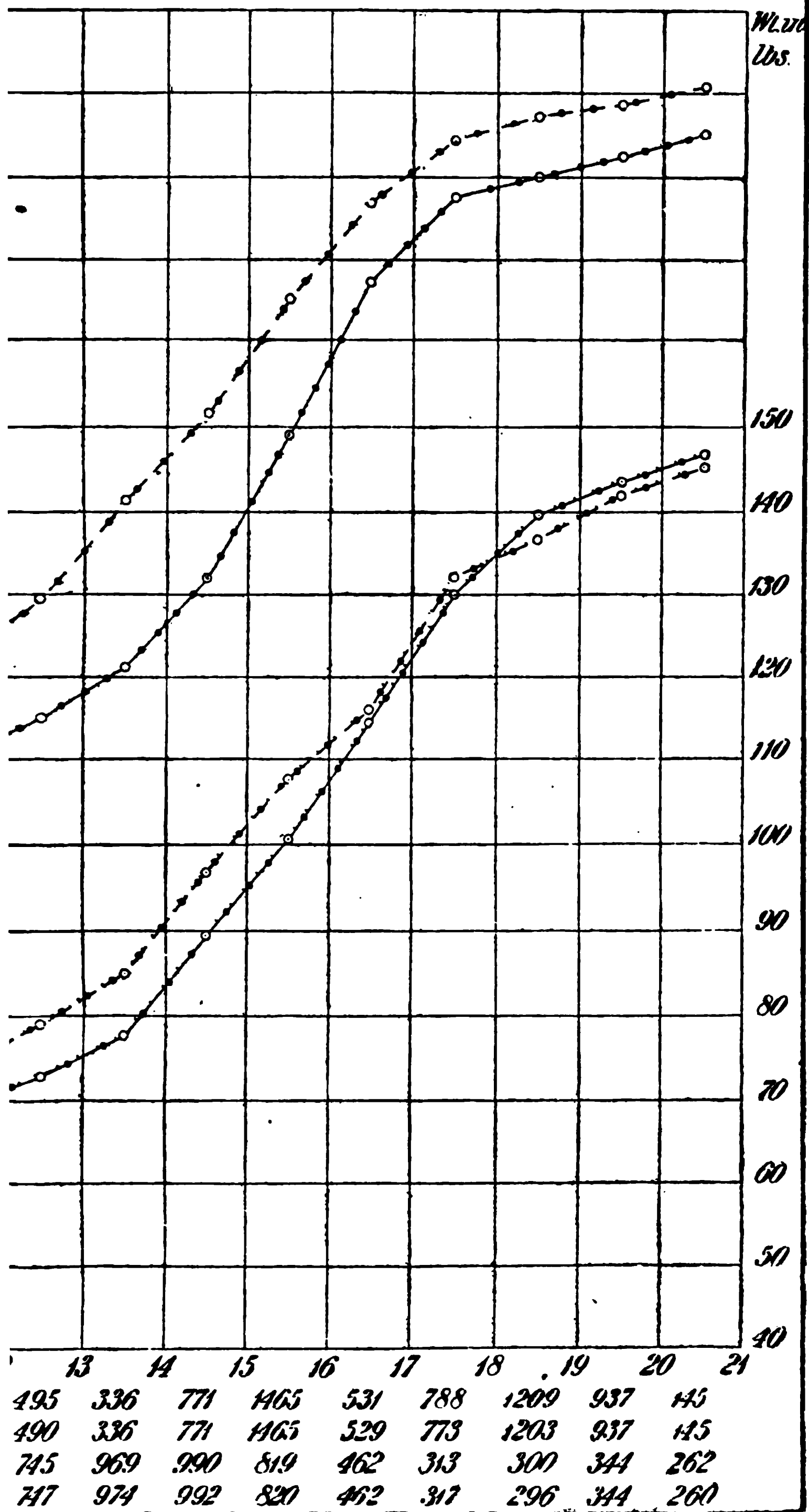
TABLE No. 20.
Showing Average Height and Weight of English Boys.—(ROBERTS.)

AGE AT LAST BIRTHDAY.	LABORING CLASSES, TOWN POPULATION ONLY.						NON-LABORING CLASSES, PUBLIC SCHOOLS, UNIVERSITIES, ETC.					
	HEIGHT WITHOUT SHOES.			WEIGHT IN ORDINARY CLOTHES.			HEIGHT WITHOUT SHOES.			WEIGHT IN ORDINARY CLOTHES.		
	No. of Obser- vations.	Inches.	No. of Obser- vations.	Pounds.	No. of Obser- vations.	Pounds.	No. of Obser- vations.	Inches.	No. of Obser- vations.	Pounds.	No. of Obser- vations.	Pounds.
5,	175	41.15	175	44.20	175	44.20	-	-	-	-	-	-
6,	387	43.18	327	49.68	327	49.68	-	-	-	-	-	-
7,	581	45.15	581	51.89	581	51.89	3	46.10	4	50.16	4	50.16
8,	670	46.81	675	55.15	675	55.15	16	47.66	18	56.40	18	56.40
9,	823	48.82	851	60.58	851	60.58	61	50.30	60	61.96	60	61.96
10,	749	50.28	829	64.59	829	64.59	235	52.65	238	67.22	238	67.22
11,	621	51.83	784	69.00	784	69.00	430	53.93	429	73.31	429	73.31
12,	495	53.02	490	72.78	490	72.78	745	55.90	747	78.96	747	78.96
13,	336	54.24	336	77.38	336	77.38	969	58.30	974	85.27	974	85.27
14,	771	56.37	771	89.39	771	89.39	990	60.27	992	96.40	992	96.40
15,	1,465	59.81	1,465	100.66	1,465	100.66	819	63.00	820	107.25	820	107.25
16,	531	63.45	529	114.55	529	114.55	462	65.34	462	115.96	462	115.96
17,	788	65.50	773	130.45	773	130.45	313	66.91	317	131.93	317	131.93
18,	1,209	66.00	1,203	139.50	1,203	139.50	300	67.38	296	136.68	296	136.68
19,	937	66.50	937	143.00	937	143.00	344	67.74	344	142.00	344	142.00
20,	145	67.00	145	146.55	145	146.55	262	68.09	260	145.23	260	145.23

Plate VIII. Showing comparative rate of growth in height and weight of the
non-laboring classes.



Weight of English Boys of the laboring and the



the non-laboring classes, the exceptions being chiefly between the ages of eighteen and twenty-one. These facts are rendered apparent by the curves constructed on Plate VIII.

In searching for the cause of this great disparity in size, it is to be noticed, in the first place, that the laboring classes in the above table are taken from the town population only, while in the case of the non-laboring classes no such restriction is observed. In the absence of exact information as to the way in which these statistics were obtained, it is difficult to draw positive conclusions, but it is probable that the influences which tend to produce a physical degeneration of urban populations,* exhibit here their effect upon the size of growing children. This tendency of city life depends upon the fact that, in the struggle for existence, physical vigor plays, in cities, a less decisive part than in the country, owing to the greater number of sedentary occupations and trades there presenting themselves, which, for their successful prosecution, neither demand nor favor a full development of the physique. It is difficult to decide how much importance should be attached to this consideration in the present case; but it must be borne in mind that wealth implies ability to choose one's occupation, and that, in England at least, an occupation exclusively sedentary is rarely adopted, except from necessity. Hence, if the term "comfort" be used to include all the favorable conditions, alimentary, hygienic, etc., which can be secured by wealth, it seems fair to conclude that, in view of the stationary character of the English population, and of the small variety of climatic conditions to which it is exposed, the above-mentioned disparity in size must be mainly due to the greater comfort enjoyed by the non-laboring classes.

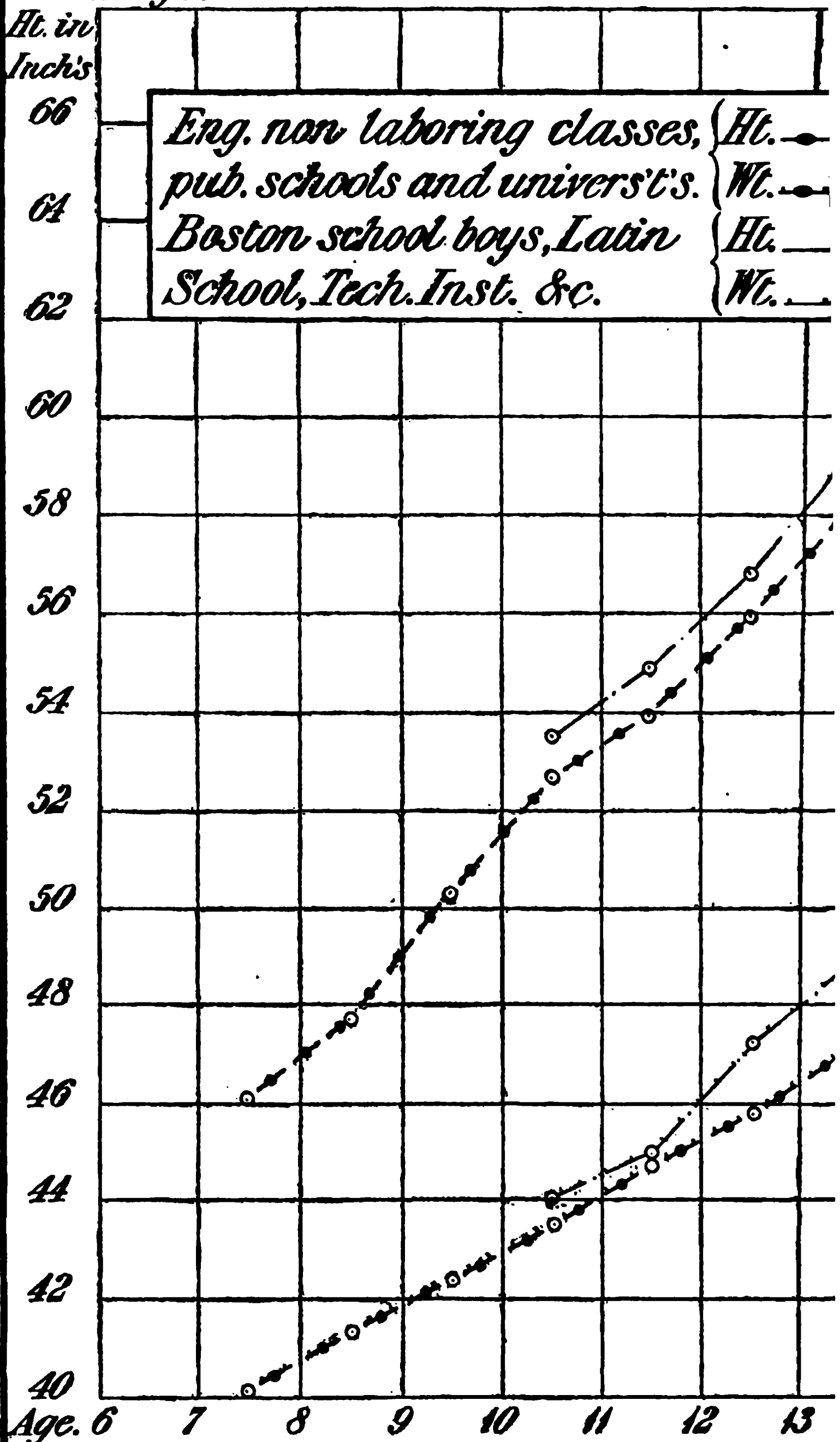
If this view is correct, it seems reasonable to suppose that the difference in size between Boston school children of American and those of Irish parentage may be, to some extent, dependent upon the greater comfort and luxury in which the former live and grow up. Whether the whole difference can be thus accounted for, or whether some other agency is concerned in bringing about this result, is a question which must be next considered.

* See De Candolle's *Histoire des Sciences et des Savants*, p. 368.

We have already seen that, according to Dr. Baxter's and Dr. Gould's investigations, the average height of the *adult* native American is greater than that of the native of any other country, and that natives of other countries, growing up in America, acquire a greater height than natives of the same countries growing up at home. We must now inquire whether similar conclusions can be reached in regard to the size of *growing children*; and in order to eliminate the effect which comfort and misery may have on the rate of growth, it is important to select, for comparison, sets of observations made upon children belonging to corresponding classes in the communities in which they live. If a comparison is made between the children of the non-laboring classes in the English public schools and universities (see Table No. 20) and the Boston school boys of American parentage (see Table No. 1), it will be seen that there is very little difference in the heights of the two sets of boys, and that the curves of growth, if constructed on the same sheet, would intersect each other at seven different points, and be nearly coincident through their whole course. In regard to weight, the American boys are, up to twelve years of age, lighter; from twelve to seventeen years heavier, and then again lighter, than English boys of the same ages. It is, however, manifest that the boys, whose dimensions are thus compared, cannot be regarded as belonging to corresponding classes in their respective communities; for there are, doubtless, a large number of native Americans to be found in the laboring classes of this city. In order to obtain a set of observations more comparable to those made on the children of the non-laboring classes in the English public schools and universities, the following table has been prepared by bringing together the measurements of the pupils of American parentage attending the public Latin School, the Massachusetts Institute of Technology, and the private Latin School of Mr. J. P. Hopkinson. It is believed that these pupils represent a class in the community corresponding sufficiently well in social condition to that class in England which sends children to the public schools and universities. A comparison of the two sets of figures shows the superiority of the American boy

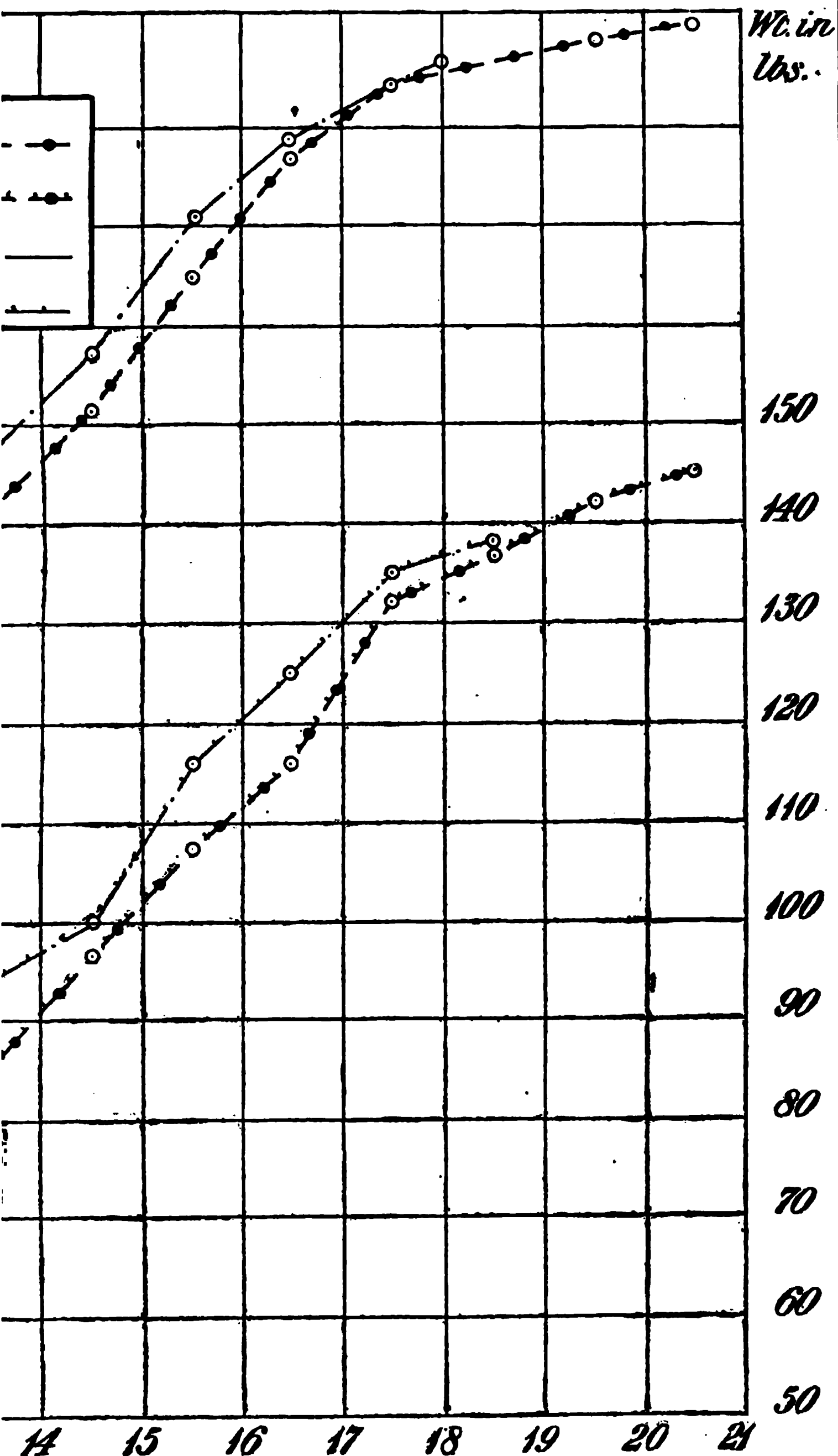
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Plate IX. Showing comparative *rez* Boys.



No. of Obs.	{ Eng.	Ht. 3	16	61	233	430	745	9
		Wt. 4	18	60	238	429	747	9
		Boston:			19	17	28	1

of growth of English and American



9	990	819	462	313	300	344	262
1	992	820	462	317	296	344	260
	49	64	68	61			



both in height and weight.* The difference is rendered at once apparent by an inspection of the curves on Plate IX. It seems, therefore, that there are influences prevailing in this community, other than those connected with the comfort or

TABLE No. 21.

Showing Average Height and Weight of Boston School-boys of American Parentage attending Public Latin School, Private Latin School, and Massachusetts Institute of Technology.

AGE AT LAST BIRTHDAY.	No. of Observa- tions.	HEIGHT WITHOUT SHOES.		WEIGHT IN ORDINARY DRESS.	
		Inches.	Centimeters.	Pounds.	Kilograms.
9,	2	52.00	132.1	60.1	27.27
10,	19	53.51	135.9	70.6	32.03
11,	17	54.90	139.4	75.3	34.16
12,	28	56.78	144.2	85.9	38.97
13,	41	59.60	151.4	94.4	42.83
14,	49	61.51	156.3	99.9	45.32
15,	46	64.20	163.1	116.0	52.62
16,	40	65.83	167.2	125.8	57.07
17,	32	} 67.44	171.3 {	135.2	61.31
18,	29			138.2	62.69
Total, . . .	303				

misery of existence, which give to a growing boy a greater height and weight than are attained by an English boy of the same age. While, therefore, the conclusions of Gould and of Baxter, as to the superior height of the adult native American, are found to be equally applicable to growing children, we find also here evidence that this superiority of stature is not dependent *solely* upon the more abundant distribution of the comforts of existence in this country, though for the reasons given above (p. 295) it seems probable that the difference is to be *partly* accounted for in this way.

In view of this result, it is reasonable to assume that the superior size of children of American parentage in the Boston schools is due in part to the greater comfort in which they live

* In confirmation of this result, it is interesting to note the statement made to the writer by a lady of his acquaintance, that London dealers in ready-made children's clothing recommend, to American customers, sizes adapted to English children one year older than those for whom the garments are purchased.

and grow up not in part in other conditions than they are accustomed collectively to infer from the fact of size. The result of these agencies in bringing about the result is greater importance than is attributed. It is a question that we are at present without the means of deciding. Some light might be thrown upon the subject by tabulating the measurements for each nationality, according to the description of the parents, and it is possible that at some future time, some circumstances favor the undertaking, the data now in hand may be utilized in the way.

The curves showing the rate of growth of the movement of selected American boys have been introduced in Plate VI. for comparison with the curves corresponding to the corresponding children of American and of Irish parentage. It is evident that the superior size of these boys in comparison with the average boys of American parentage attending the public schools, cannot be attributed exclusively to either of the factors which have been recognized as increasing the dimensions of growing children; for in the first place, the environment in which the pupils of these selected schools live and grow up must be greater than that enjoyed by the generality of children of American parentage attending the public schools; and in the second place, their ancestors for several generations are probably, in the majority of cases, American; while the children with whom they are compared, though of American parentage, doubtless have, in a great many instances, foreign grandparents. Hence, whatever tendency residence in America may have to increase the size of growing children, will, in their cases, be intensified by transmission through several generations.

The characteristics which distinguish the various races of men result from slow modifications of a common ancestral type by the action through successive generations of the varying conditions under which growth and development take place. It is therefore interesting to inquire how *quickly* the type of a race may be altered by a change in the external conditions of development. We have already seen that, as far as the height of the adult individual is concerned, a single generation is, according to Dr. Gould, sufficient to produce a marked effect. A most striking proof of this statement is

and grow up, and in part to other conditions which may be described collectively as differences of race or stock. To which of these agencies in bringing about the result the greater importance is to be attributed, is a question which we are at present without the means of deciding. Some light might be thrown upon the subject by tabulating the observations for each nationality according to the occupation of the parents, and it is possible that at some future time, should circumstances favor the undertaking, the data now on hand may be utilized in this way.

The curves showing the rate of growth of the above-mentioned selected American boys have been introduced into Plate VI. for comparison with the curves corresponding to the observations on children of American and of Irish parentage. It is evident that the superior size of these boys, in comparison with the average boys of American parentage attending the public schools, cannot be attributed exclusively to either of the factors which have been recognized as influencing the dimensions of growing children; for in the first place, the comfort in which the pupils of these selected schools live and grow up must be greater than that enjoyed by the *generality* of children of American parentage attending the public schools; and in the second place, their ancestors for several generations are probably, in the majority of cases, American; while the children with whom they are compared, though of American parentage, doubtless have, in a great many instances, foreign grandparents. Hence, whatever tendency residence in America may have to increase the size of growing children, will, in their cases, be intensified by transmission through several generations.

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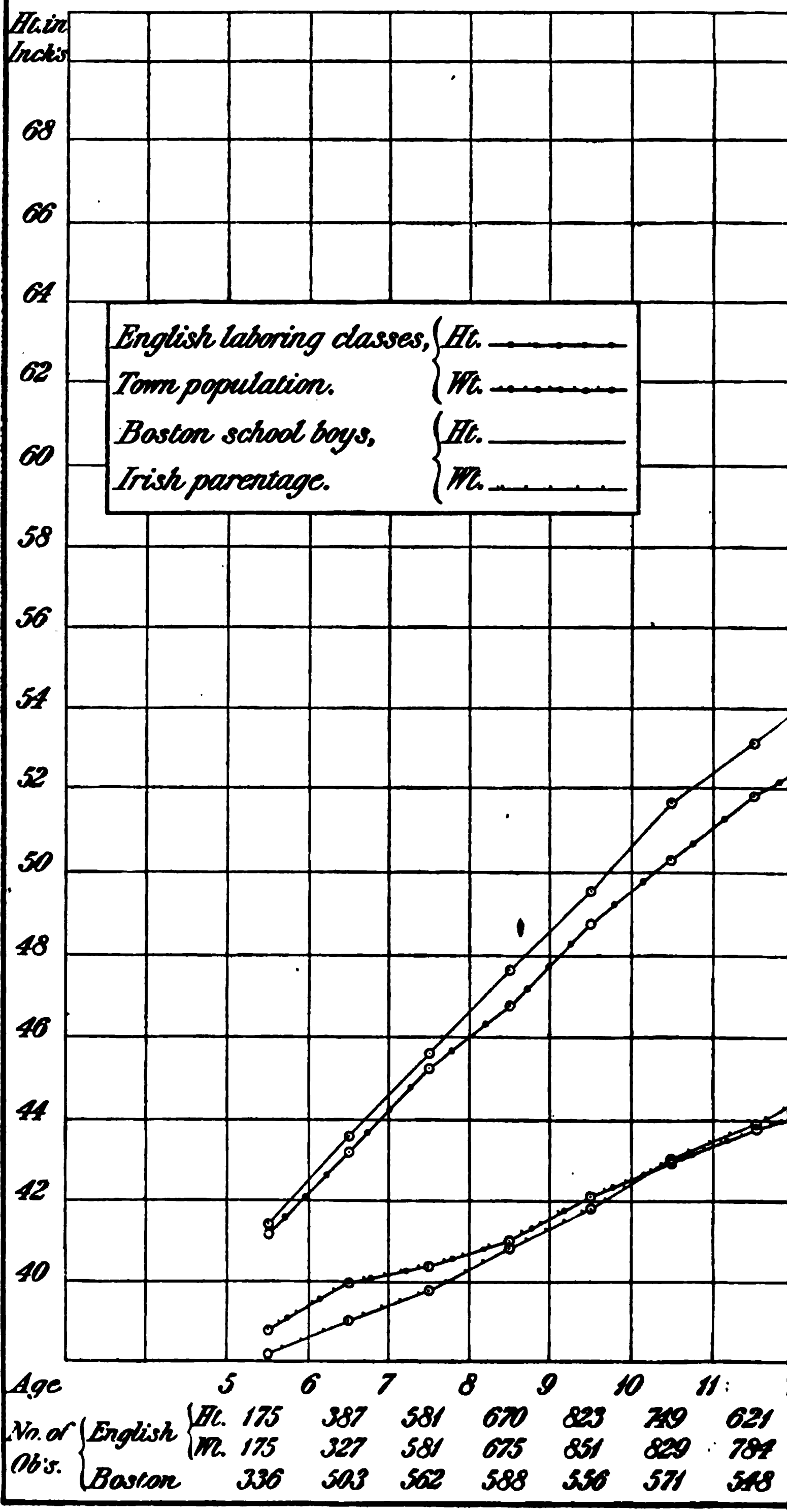
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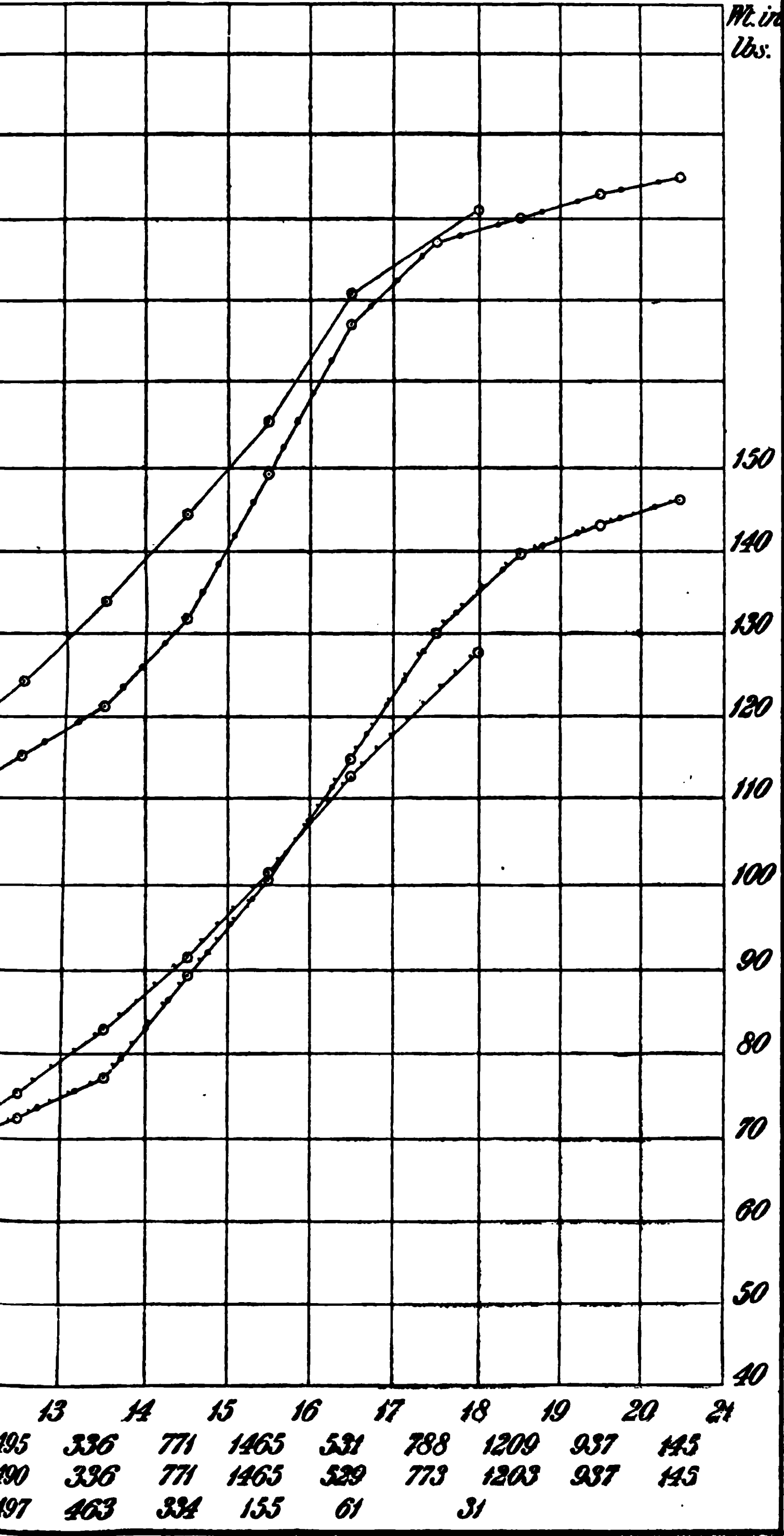
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Plate X. Showing comparative rate of growth



of English and American Boys.



afforded by the tables given by this writer,* showing that natives of New England and New York enlisting in the Western States have, at all ages from eighteen years upwards, a greater average height than natives of the same regions enlisting at home, thus approximating to the stature of the natives of those States where they grew up and enlisted. It was hoped at the beginning of this inquiry that it might be possible to ascertain whether local conditions have a similar effect on the size of growing children, but it has been found impossible to collect data which will warrant any positive conclusions on this subject. The only foreign nation largely represented in this community is the Irish; and all attempts by correspondence with English statisticians to discover any record of observations on the size of Irish children in their native country have been unavailing. A comparison may be instituted between the children of the laboring classes in England (see Table No. 20) and those of Irish parentage in this community (see Table No. 1); and the difference shown by the curves on Plate X. is, as far as height is concerned, in favor of the Boston children; while in regard to weight, the English children are at first heavier, then lighter, and then again heavier than Boston children of the same ages. Conclusions as to the effect of climatic conditions on the size of growing children could, however, be drawn from this comparison only on the assumption, first, that among the laboring classes the size of Irish children does not differ greatly from that of English children; secondly, that the children of Irish parents in this community belong wholly, or in a large proportion, to the laboring classes; and thirdly, that the condition of the laboring classes in this community is comparable, as to comforts of life, with that of the laboring classes of England. None of these assumptions can be safely made, and it must therefore remain doubtful to what cause the difference of size between the two sets of children (amounting at thirteen years of age to over two inches in height) is really to be attributed.

A comparison between the heights of boys of German parentage in this city and that of growing boys in German cities is not without interest. The following table shows in

* *Op. cit.*, pp. 126, 127.

parallel columns the heights of boys measured in Berlin by Schadow, and of boys measured in Cologne by Angerstein, compared with the heights of boys of German and American parentage attending the schools of this city. The curves on Plate XI. have been constructed from the figures of this table (the curve of growth of children of American parents being omitted in order not to confuse the diagram). It will be noticed that while the curves of growth of boys living in the German cities indicate a great difference in the rate of increase before and after eleven years of age, the rate of growth of boys of both German and American parentage in this city is much more uniform throughout the whole growing period.

TABLE NO. 22.

Showing Comparative Rate of Growth of American and German Boys.

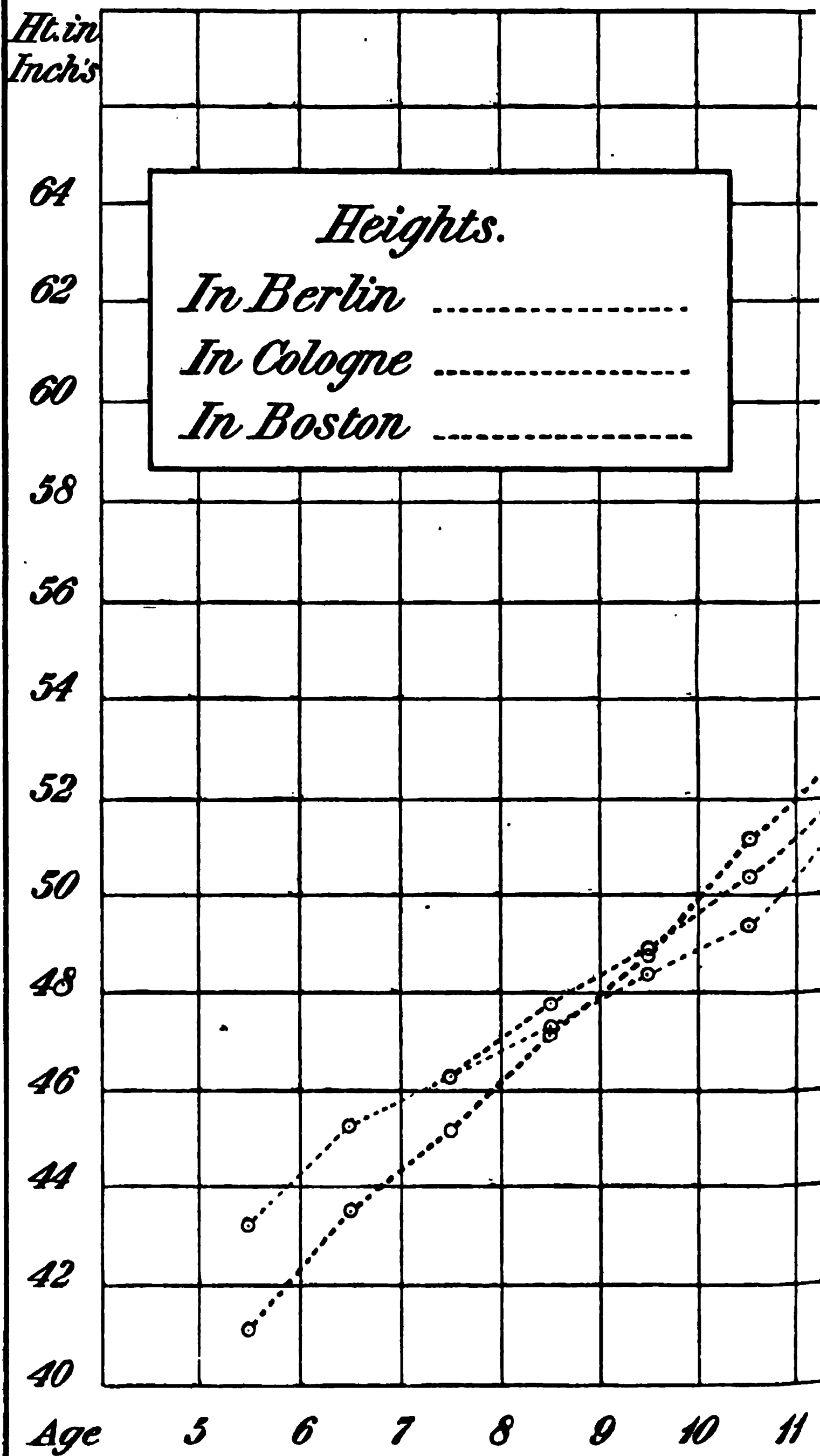
AGE.	BERLIN. (SCHADOW.)		COLOGNE. (ANGERSTEIN.)		BOSTON.			
					GERMAN PARENTAGE.		AMERICAN PARENTAGE.	
	Inches.	Centim.	Inches.	Centim.	Inches.	Centim.	Inches.	Centim.
5, .	43.24	109.8	—	—	41.08	104.3	41.74	106.0
6, .	45.32	115.1	—	—	43.50	110.5	44.10	112.0
7, .	46.34	117.7	46.31	117.6	45.25	114.1	46.21	117.4
8, .	47.35	120.3	47.83	121.5	47.13	119.7	48.16	122.3
9, .	48.40	122.9	48.90	124.2	48.85	124.1	50.09	127.2
10, .	49.38	125.4	50.43	128.1	51.21	130.1	52.21	132.6
11, .	51.45	130.7	51.97	132.0	52.92	134.4	54.01	137.2
12, .	54.57	138.6	54.54	138.5	54.55	138.6	55.78	141.7
13, .	57.65	146.4	58.67	149.0	56.70	144.0	58.17	147.7
14, .	60.71	154.2	61.77	156.9	59.14	151.2	61.08	155.1
15, .	65.91	167.4	64.34	163.4	62.06	157.6	62.96	159.9
16, .	—	—	65.88	167.3	} 64.75	164.4 {	65.58	166.5
17, .	—	—	66.40	168.6			66.29	168.4
18, .	—	—	66.91	169.9			66.76	169.5

The figures in the above table, representing the heights of Berlin and Cologne boys, though apparently averages of a number of observations, are really more of the nature of estimates. This is evident from an examination of the original tables as given by Angerstein,* where the heights for each age are, in most instances, expressed in an even number of German inches. Moreover, the observations on boys of German

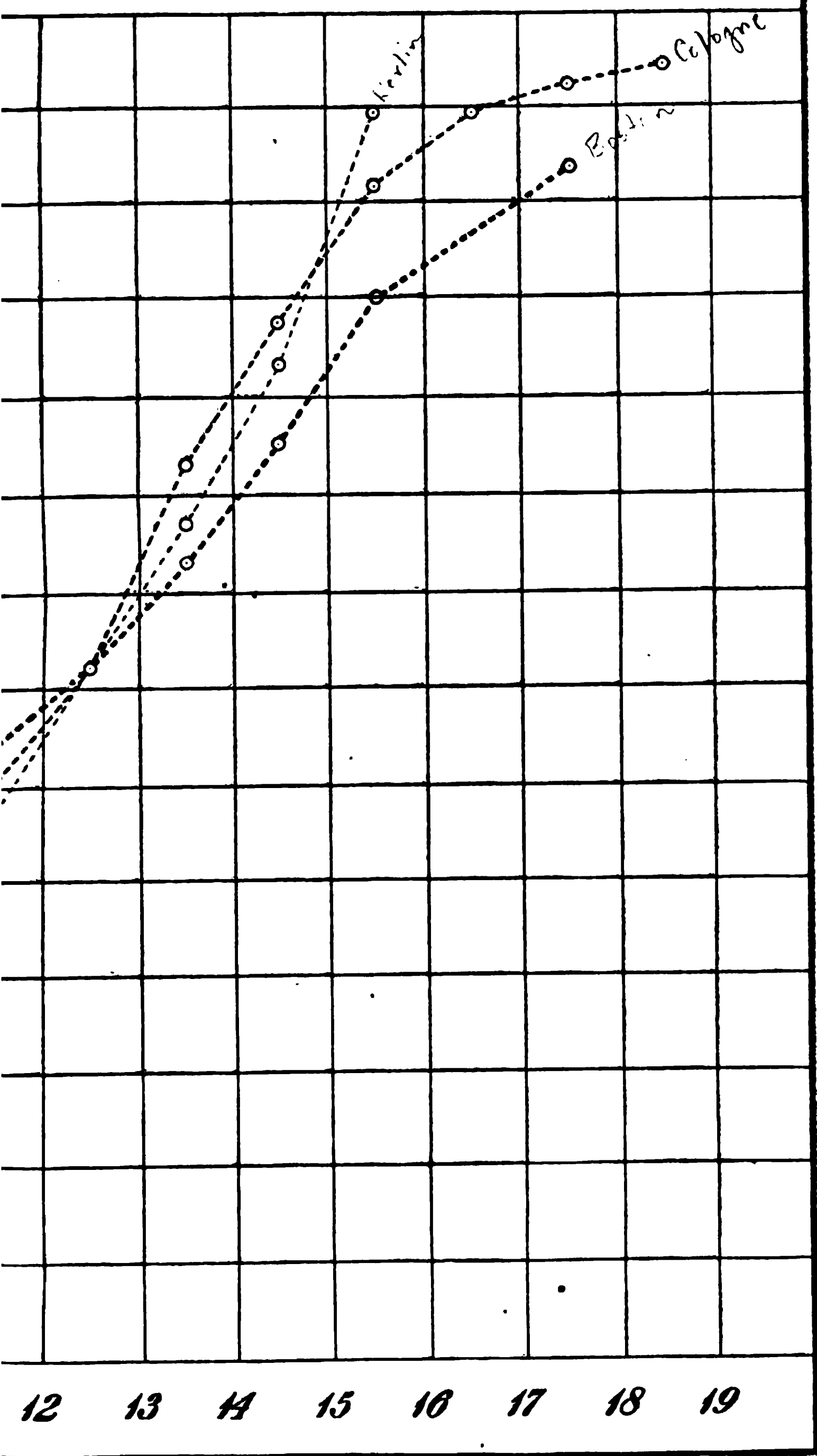
* Deutsche Turnzeitung, 1864, p. 328.

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Plate XI. *Showing rate of growth and in America.*



of German boys in Germany



parentage in this city are few in number (752 of all ages), and there has been no attempt to distinguish between natives of different parts of Germany. It is therefore impossible to draw positive conclusions on the subject; but the evidence, as far as it goes, seems to indicate that even in the first generation after emigration, the rate of growth has been modified by new external conditions.

RELATION OF HEIGHT TO WEIGHT.

The data collected in this investigation afford the means for ascertaining the relation of height to weight in growing children of both sexes and of various races. This relation is for each age most simply expressed by the quotient of the weight in pounds divided by the height in inches. Series of quotients thus obtained are given in Table No. 3, in the columns headed "pounds per inch." Since, however, these quotients increase with the increasing height,* it is manifestly impossible to use them for ascertaining the relative stoutness of children who at a given age differ from each other in stature. To do this with absolute accuracy, it would be necessary to determine for each age, and in each set of observations, the average weight corresponding to each height. Since, however, the direct determination of this value would necessitate a complete retabulation of all the observations, it has been thought best to adopt an indirect and somewhat less accurate method of getting at the result. This method consists in arranging the heights and weights corresponding to each age, opposite to each other in parallel columns, and then determining by interpolation the weights corresponding to each even inch of height.†

* Uniform growth in all dimensions would of course cause the weights of growing children to vary as the cubes of the heights, but since growth is more rapid in the vertical than in the lateral dimensions, the weights increase approximately as a lower power of the heights. A logarithmic equation, however, as given in the appendix to this article, expresses the relation much more accurately. For a discussion of the question the reader is referred to the works of Quetelet and Gould.

† This method is defective, first, because it does not take into account the possible influence of age upon the ratio of a given height to its corresponding weight; and secondly, because it rests upon the assumption that the average weight for a given age is the same as the average weight of all individuals, without regard to age, whose height is equal to the average height for that age. This assumption clearly involves a trifling error, for, since the weights of growing children increase approximately as the 2.7 powers of the heights, it is evident that at any given age the weight of those children

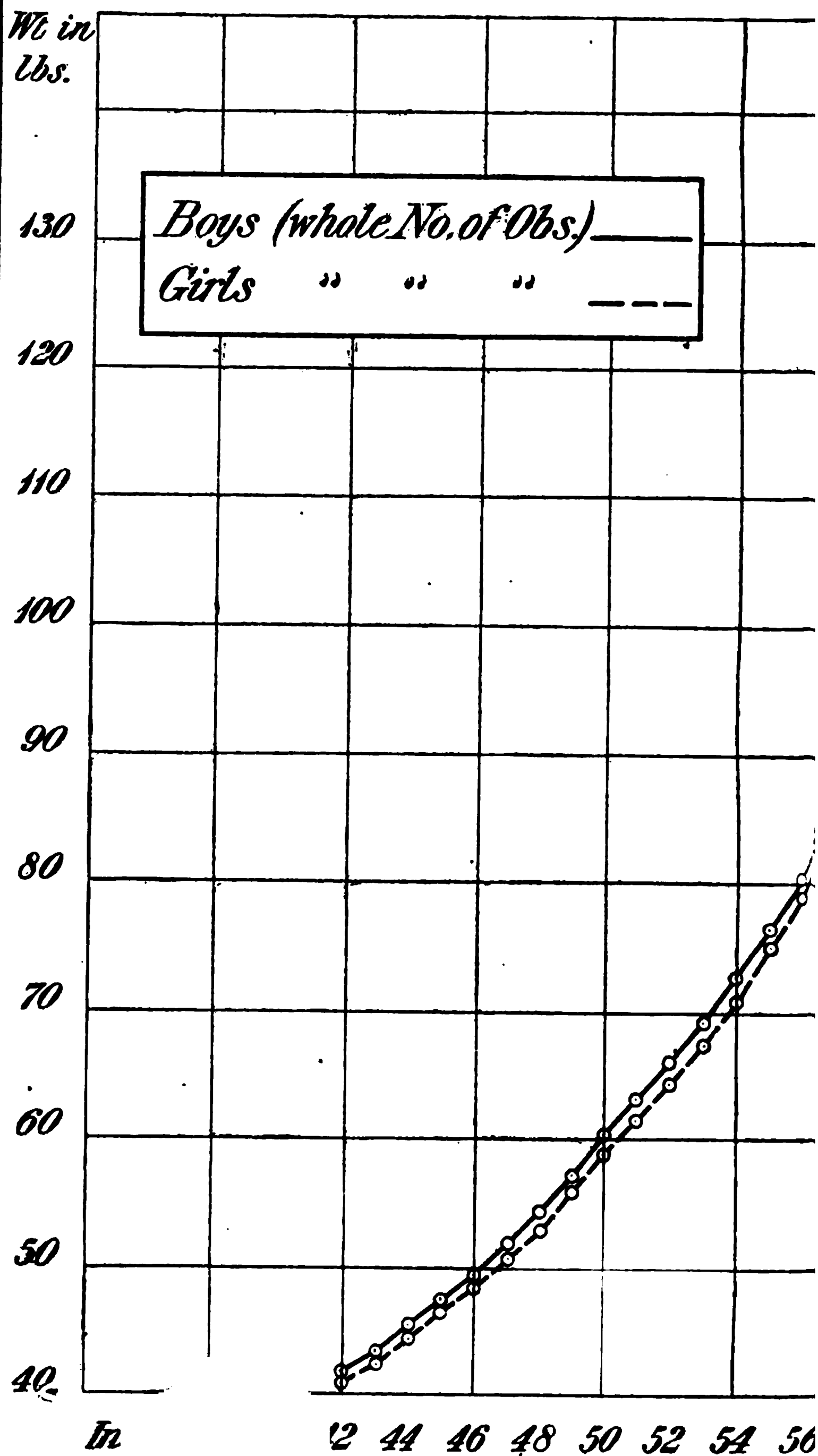
The results of this calculation are given in Tables Nos. 23 and 24, which show for every inch of height the corresponding weight of growing children of both sexes and in various conditions of life.

TABLE No. 23.
Showing Relation of Height to Weight in Growing Boys. (Weight given in Pounds.)

HEIGHT, inches.	BOSTON SCHOOL BOYS.						ENGLISH BOYS.		Latin School, Technology Institute, etc.
	PARENTAGE.					Totals.	Laboring.	Non-laboring.	
	American.	Irish.	American and Irish.	German.	One or both English.				
42	41.63	42.07	41.68	41.90	41.40	41.77	46.50	-	-
43	43.29	43.87	43.63	43.38	43.59	43.60	49.18	-	-
44	44.98	45.76	45.64	45.49	45.60	45.63	50.58	-	-
45	47.00	47.69	47.68	48.41	47.24	47.58	51.71	-	-
46	49.03	49.83	49.72	50.64	49.25	49.65	53.55	-	-
47	51.45	52.34	51.76	52.67	51.97	52.07	55.63	53.77	-
48	54.03	54.84	54.05	55.64	54.60	54.57	58.35	57.12	-
49	56.81	57.48	56.52	58.59	57.49	57.31	61.10	59.23	-
50	59.69	60.31	59.75	61.09	60.32	60.20	63.82	61.34	-
51	62.82	63.29	63.32	63.41	63.24	63.23	66.79	63.53	-
52	65.95	66.28	66.47	66.30	65.71	66.27	69.52	65.74	60.10
53	69.11	69.27	69.35	69.42	67.85	69.20	72.70	68.86	67.03
54	72.33	72.77	72.30	73.45	71.82	72.73	76.46	73.50	72.24
55	76.55	76.41	75.28	77.41	75.94	76.44	81.70	76.36	75.86
56	80.66	80.19	78.82	81.16	80.98	80.24	87.22	79.21	81.44
57	84.12	84.00	82.67	84.93	85.44	84.04	91.41	81.86	86.58
58	87.58	87.85	86.65	88.63	88.48	87.86	94.68	84.51	89.55
59	91.34	91.69	90.73	92.32	91.52	91.58	97.95	89.16	92.70
60	95.20	96.20	-	97.26	95.26	95.51	101.35	94.84	95.55
61	98.94	100.50	-	102.10	99.25	100.54	105.10	99.22	98.41
62	105.06	104.71	-	107.23	105.41	105.63	108.99	103.23	102.79
63	111.03	108.56	-	-	113.24	110.71	112.88	107.25	108.75
64	115.97	112.52	-	-	-	115.86	118.84	110.90	114.71
65	120.84	-	-	-	-	121.01	126.47	114.65	120.90
66	126.70	-	-	-	-	126.61	139.50	122.66	126.94
67	-	-	-	-	-	136.09	146.55	132.88	133.64
68	-	-	-	-	-	-	-	144.37	-

who are above the average height will tend to raise the average weight for that age more than the weights of the children below the average height will tend to lower it, supposing the observations to be uniformly distributed on both sides of the average according to the binomial curve of Quetelet; consequently the average weight for a given age will be somewhat greater than the average weight of all the individuals, regardless of age, whose height is equal to the average height for that age. Notwithstanding these defects, the method has been adopted, first, because it is believed that the errors involved are so small as to be of no practical importance; and secondly, because relative rather than absolute values were sought, and a comparison between several sets of observations is not prevented by a small constant error running through them all.

Plate XII. Showing relation of height and weight of children.



Height to weight in Boston school

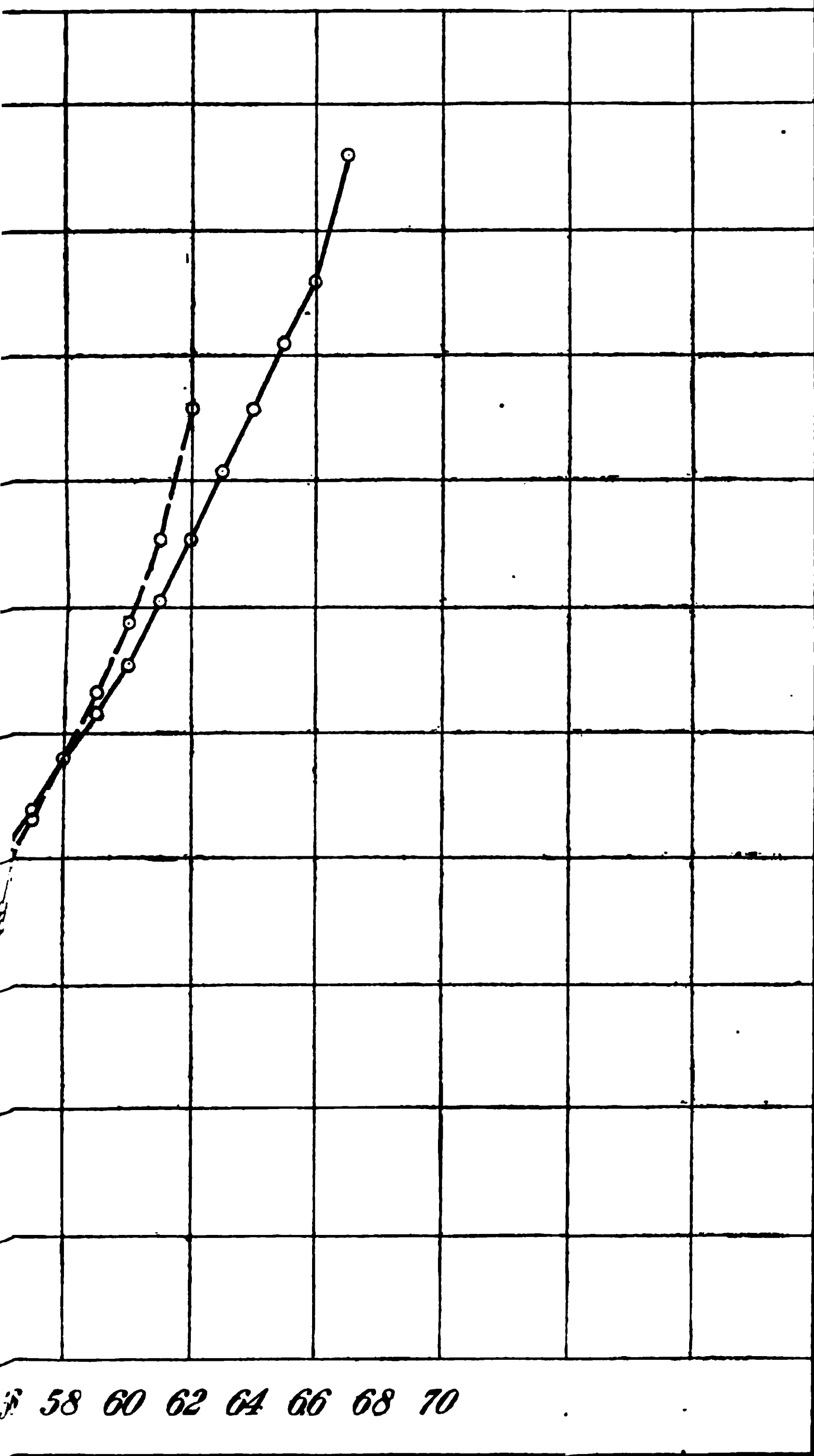


TABLE No. 24.

Showing Relation of Height to Weight in Growing Girls. (Weight given in pounds.)

HEIGHT, inches.	BOSTON SCHOOL GIRLS.					
	PARENTAGE.					Totals.
	American.	Irish.	American and Irish.	German.	One or both English.	
42,	40.77	41.02	41.39	40.76	40.74	40.89
43,	42.61	42.70	42.77	42.50	42.79	42.62
44,	44.44	44.67	44.38	44.42	44.64	44.53
45,	46.25	46.71	46.08	46.43	46.67	46.45
46,	48.16	48.80	47.98	48.34	48.85	48.51
47,	50.47	50.96	50.23	50.29	51.02	50.71
48,	52.78	53.38	52.70	53.37	53.19	53.19
49,	55.68	56.01	55.30	56.69	55.25	56.06
50,	58.70	58.59	57.92	58.64	57.96	58.75
51,	62.02	61.10	60.71	60.83	61.04	61.39
52,	64.76	64.14	63.56	64.93	64.32	64.36
53,	67.85	67.39	66.51	69.09	67.66	67.54
54,	70.92	70.99	70.30	73.08	70.97	71.01
55,	74.14	74.65	74.89	76.90	74.33	74.90
56,	77.46	78.74	78.74	80.06	77.78	78.82
57,	80.79	82.97	82.71	83.18	82.81	83.38
58,	86.55	87.56	87.20	86.56	87.86	87.92
59,	92.64	92.86	94.60	93.32	92.80	93.29
60,	98.49	98.04	101.80	—	97.86	98.81
61,	105.44	107.83	109.04	—	106.14	105.39
62,	115.75	115.82	—	—	110.75	115.69

The following conclusions may be drawn from an examination of the tables :—

I. Growing boys are heavier in proportion to their height than growing girls until the height of 58 inches (147.9 c. m.) is reached. Above that point the reverse is the case. This is true in all the various sets of observations. The fact is rendered apparent by the curves on Plate XII., where the ordinates represent the weight in pounds corresponding to each inch of height, the values being calculated from the average dimensions of all the Boston school children measured, irrespective of the nationality of the parents. The height of 58 inches is attained in the 14th year, and it seems probable that the reversal in relative proportions of the two sexes may be connected with the accumulation of adipose tissue which occurs in girls at about the period of puberty.

II. The difference between children of American and those

of foreign parents is constant in one direction for all ages, only in the case of boys of German parentage. These, as will be seen by the curves on Plate XIII., are uniformly heavier in proportion to their height than the sons of American born parents.

III. The children of the laboring classes in England are, as shown by the curves on Plate XIV., decidedly heavier in proportion to their height than those of the non-laboring classes. This fact, taken in connection with the differences in absolute height and weight of the same children (as shown by the curve on Plate VIII.) seems to indicate that deprivation of the comforts of life has a greater tendency to diminish the stature than the weight of a growing child.

IV. A comparison of the pupils of the selected Boston schools above mentioned with the children of the English non-laboring classes at the public schools and universities, shows that the former are in general heavier, in proportion to their height, than the latter (see Plate XV.). It seems, therefore, that the influences above alluded to (p. 297) which give to a growing boy in this community a greater height and weight than are attained by an English boy of the same age, affect the weight more powerfully than the height, and that the Boston boy is therefore by no means to be described as tall and thin in comparison with his English cousin. Dr. Baxter's conclusion, "that the mean weight of the white native of the United States is not disproportionate to his stature"* seems, therefore, as far as these boys are concerned, as applicable to growing children as to adults.

It will thus be seen that the theory of the gradual physical degeneration of the Anglo-Saxon race in America derives no support from this investigation.†

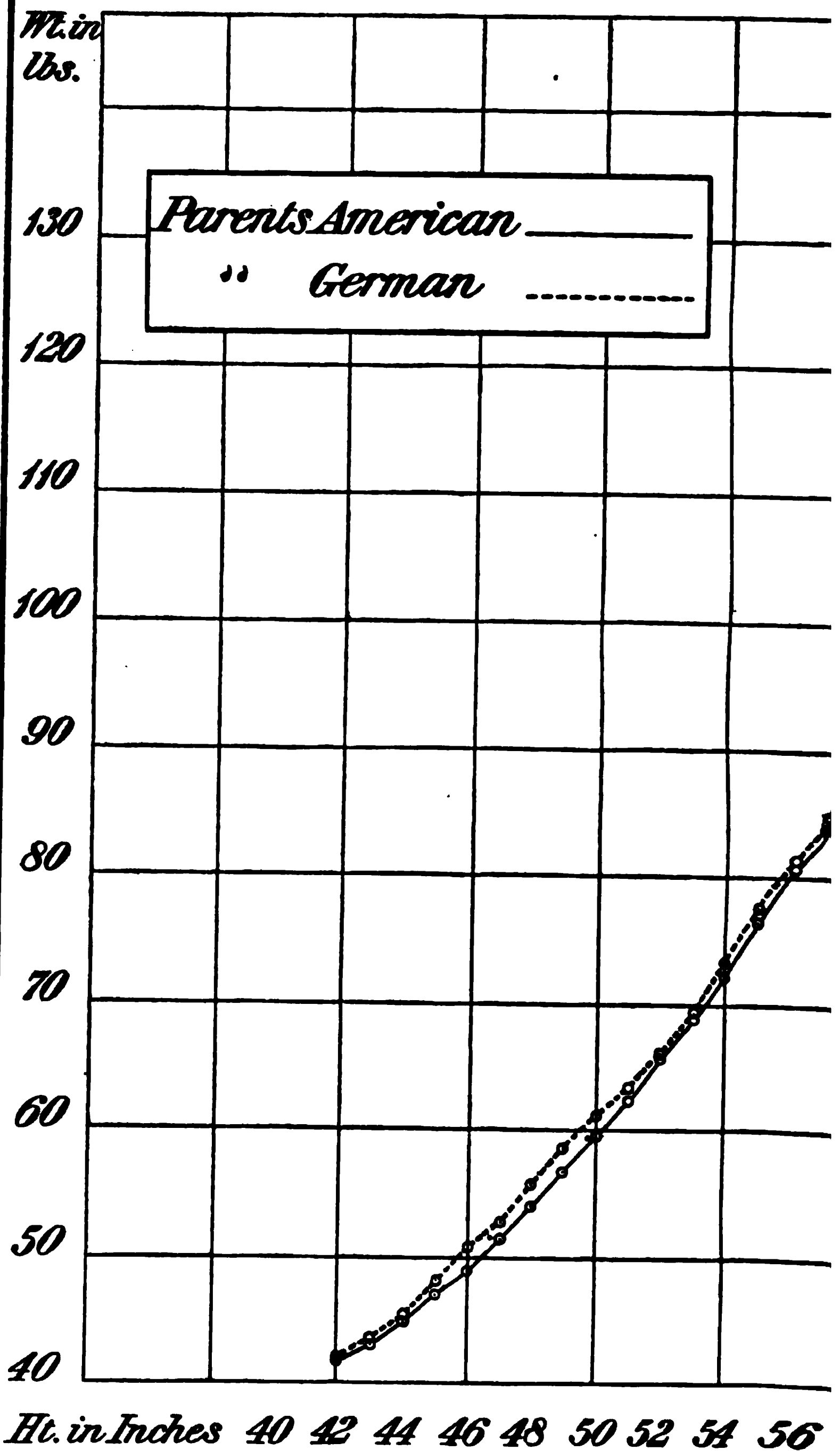
DISTRIBUTION OF OBSERVATIONS.

Tables Nos. 4 to 15, inclusive, show the distribution of the observations on both height and weight. For instance, from Table No. 4, it will be seen that, of the 848 boys of five years of age whose heights were measured, four (or 0.47 per cent. of the whole number) were between 47 and 48 inches high,

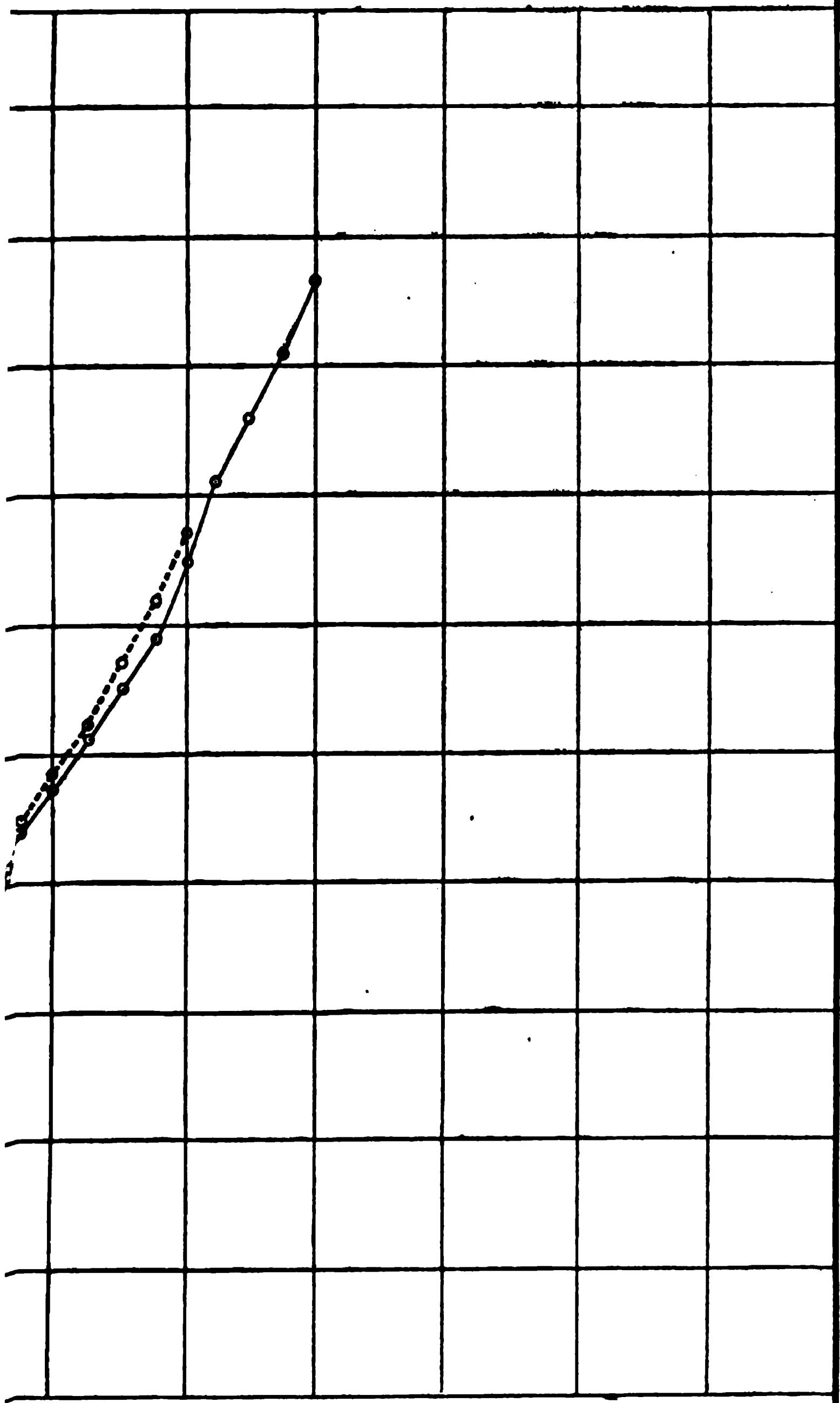
* Op. cit., p. 55.

† See an article on this subject by Rev. A. A. Livermore, in the February number of the "Unitarian Review and Religious Magazine."

Plate XIII. Showing relation of school boys.



Height to weight in Boston



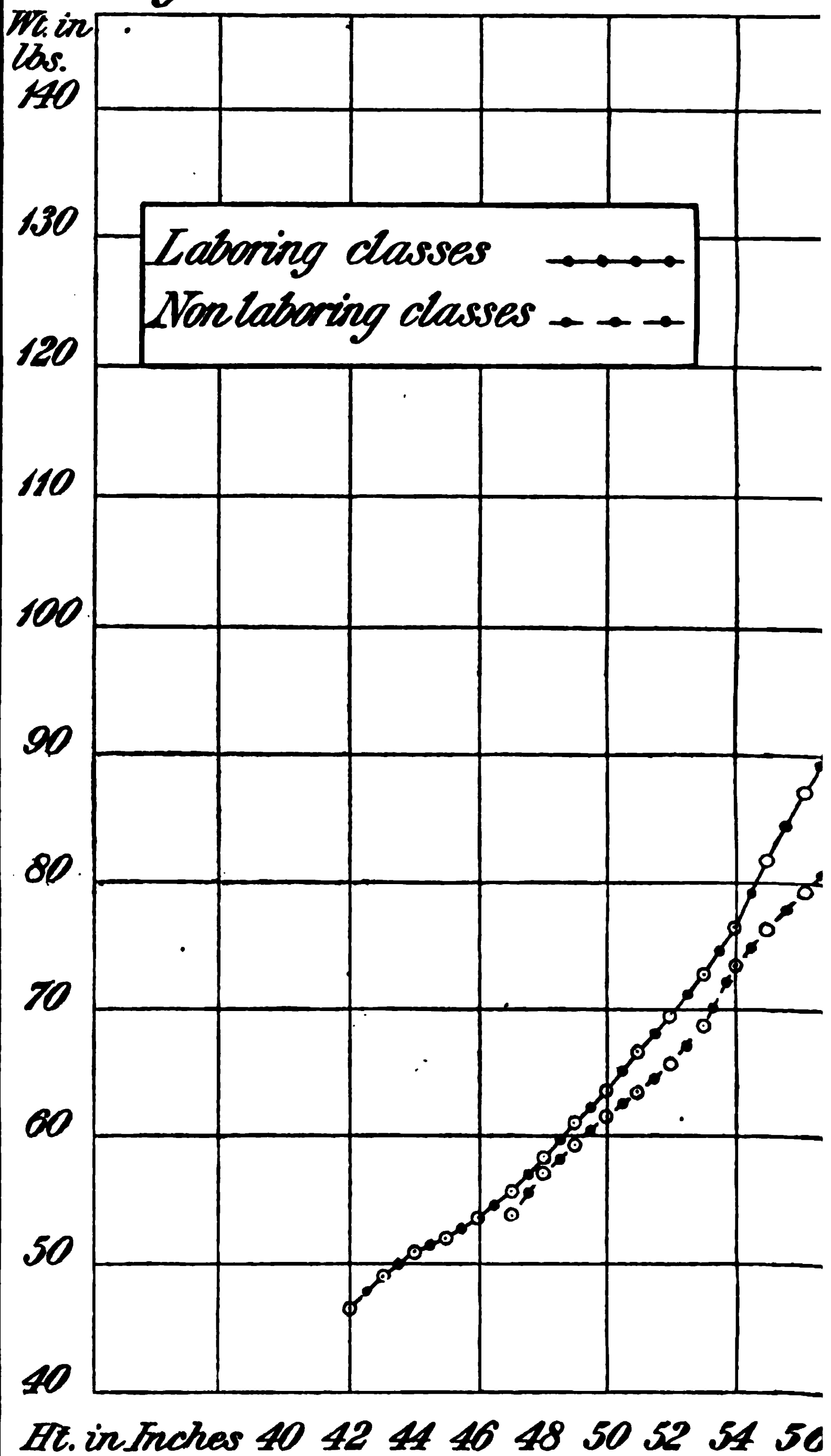
58 60 62 64 66 68 70



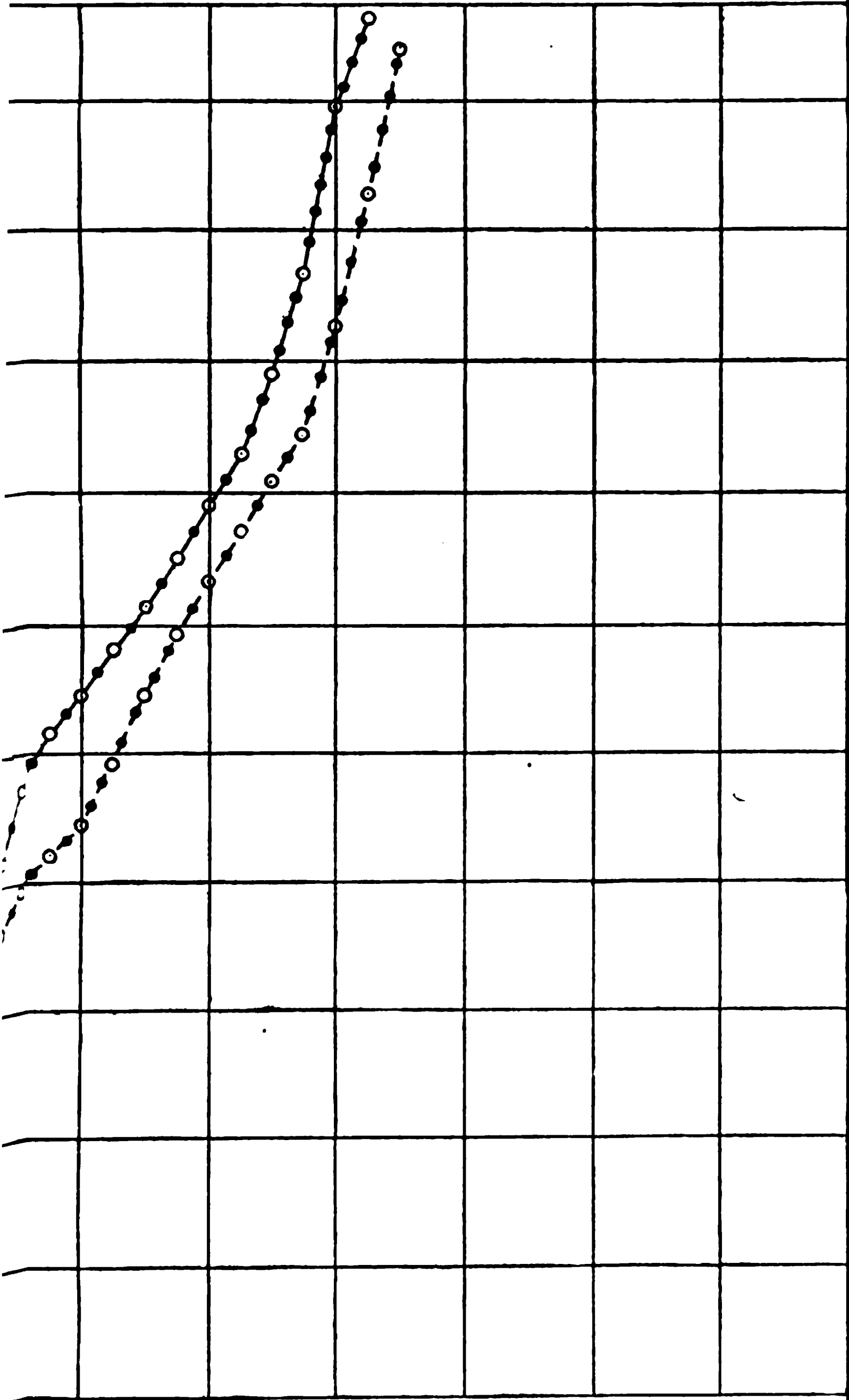
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Plate XIV. Showing relation of Boys.



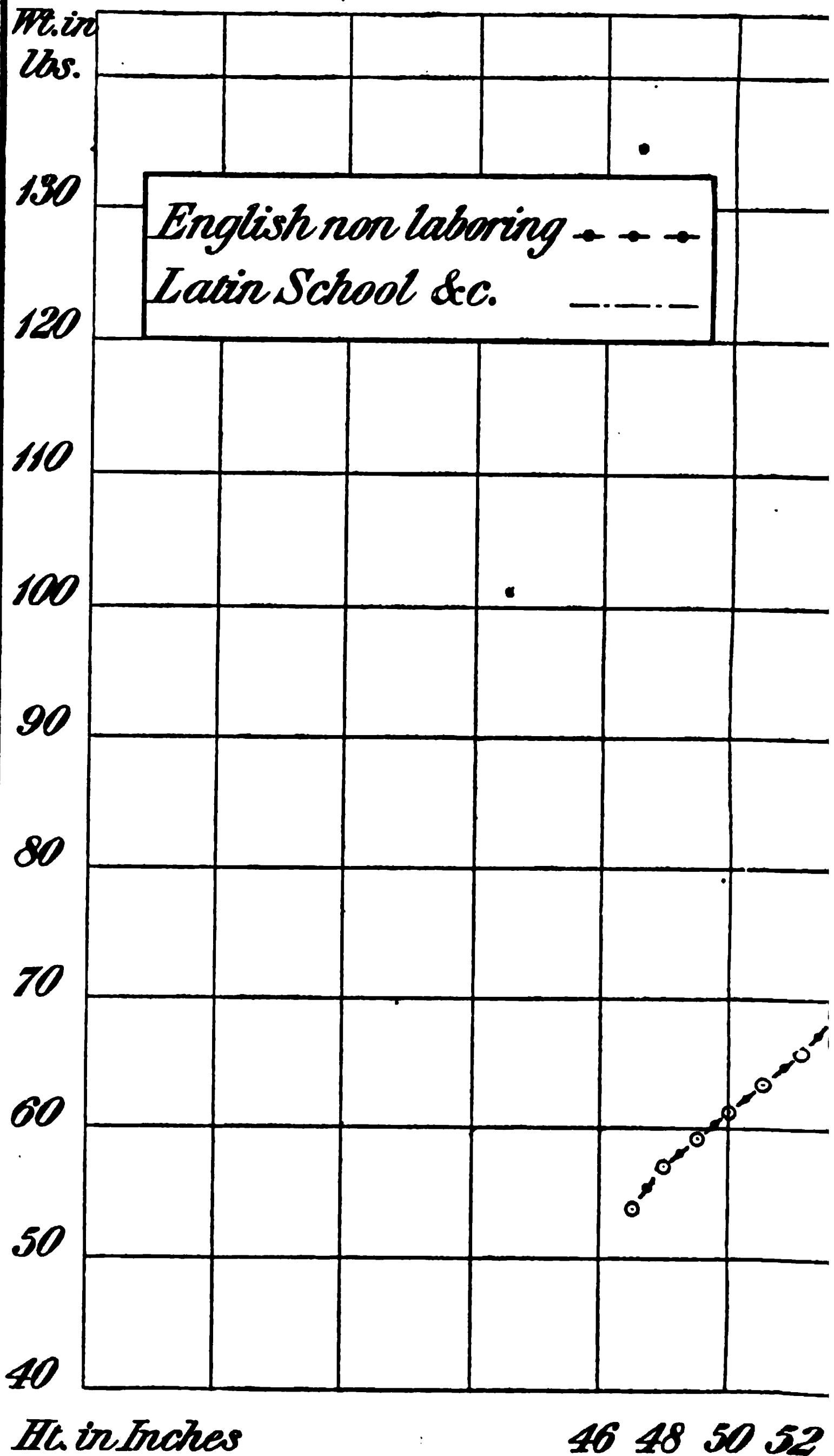
of height to weight in English



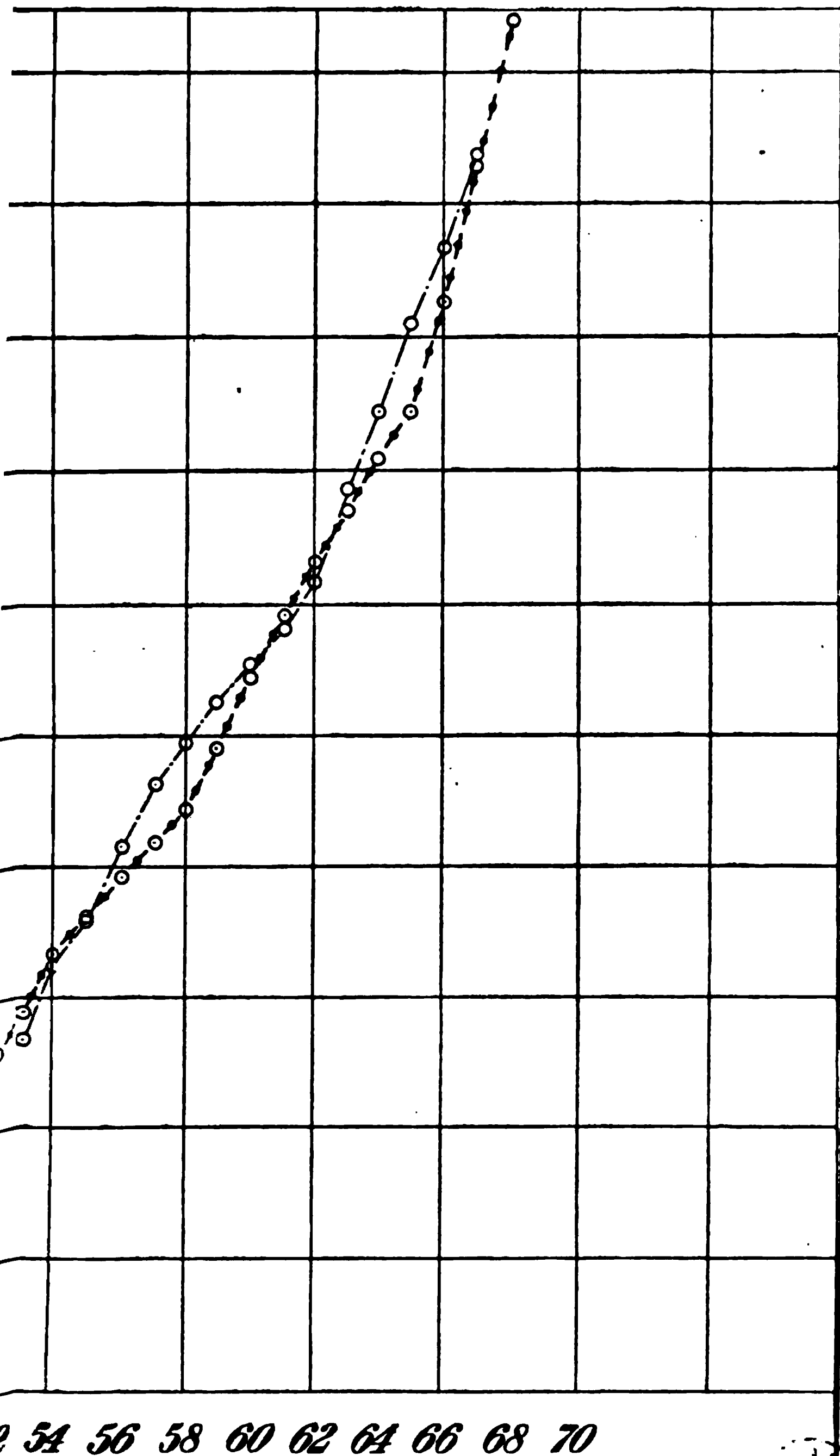
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Plate XV. Showing relation of and American Boys.



Height to weight in English



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190 (or 22.4 per cent. of the whole number) were between 41 and 42 inches high, etc. The distribution of observations on both sides of the average height or weight may be represented, according to Quetelet, by the binomial curve. That is, if the individuals measured are sufficiently numerous, it will be found that the number of observations at each successive inch (or pound) will first increase and then diminish in the same way as the successive coefficients of $(a + b)^n$, as determined by Newton's binomial theorem. It will be noticed that the figures in the above-mentioned tables do not increase and diminish with the regularity which a conformity with this law demands; but it must be borne in mind that the observations at each age are comparatively few in number, and that more numerous measurements or a distribution of the present observations in larger groups (*e. g.*, of two inches, or of eight pounds each) would doubtless cause the appearance of a closer agreement with the law.

These tables (Nos. 4 to 15) show at a glance the range of variation in height and weight at each age. It will be noticed that the range gradually increases with age (except where the whole number of observations is comparatively small), while the percentage of observations at the average height or weight, as a rule, diminishes. The most remarkable instances of variation from the normal dimensions are those of a boy five years old, and but thirty inches in height; and of three girls, 14, 16, and 18 years of age, weighing upwards of two hundred pounds.

WEIGHT OF CLOTHES.

It will be noticed that in this investigation the weight of the children has been given "in ordinary clothes," and no attempt has been made to ascertain the net weight by making an allowance for the clothing. This course was adopted because most of the observations with which comparisons were to be made had been taken in this way; but in order to facilitate a comparison of these records with others, in which a deduction is made for the weight of the clothes, an effort has been made to determine the average weight of the ordinary indoor clothing of children of different ages. For this purpose 317 pupils of both sexes, of various ages, and living in several different quarters of the city, were requested by the principals of their

respective schools to ascertain and to report the weight of the garments worn at the time the observations were taken. From the data thus collected at various seasons of the year, the following table has been computed, showing in parallel columns, for each age, the number of observations, the

TABLE NO. 25.

Showing Average Weight of Clothes Worn by School Children.

AGE AT LAST BIRTHDAY.	BOYS.				GIRLS.			
	No. of Observations.	AVERAGE WEIGHT IN POUNDS.		Percentage weight of clothes.	No. of Observations.	AVERAGE WEIGHT IN POUNDS.		Percentage weight of clothes.
		Gross weight.	Clothes.			Gross weight.	Clothes.	
5,	5	44.22	2.85	6.45	8	41.84	2.84	6.79
6,	14	43.51	3.13	7.19	9	43.90	2.90	6.61
7,	22	52.79	3.44	6.52	20	47.82	3.59	7.51
8,	13	56.15	4.06	7.23	21	53.69	3.51	6.54
9,	12	59.85	4.76	7.95	17	61.07	4.23	6.93
10,	9	63.25	5.72	9.04	20	66.45	4.54	6.83
11,	4	67.69	6.69	9.88	17	70.97	4.88	6.88
12,	11	78.29	7.27	9.29	15	82.96	5.64	6.80
13,	12	88.19	7.40	8.39	11	96.88	5.66	5.85
14,	17	99.22	8.09	8.15	14	111.47	7.54	6.76
15,	10	103.65	8.08	7.80	13	107.23	7.85	7.32
16,	7	120.30	9.67	7.86	8	117.16	8.09	6.90
Total,	136	-	-	-	181	-	-	-
Average for all ages, . . .	-	-	-	7.99	-	-	-	6.81

average gross weight of the pupils, the average weight of the clothes, and the percentage weight of the clothes referred to the gross weight of the individual. From this table it will be seen that, except in the case of very young children, both the absolute and the percentage weight of the clothing is, at any given age, greater for boys than for girls. The average weight of the clothes for all ages is, for boys, 8 per cent., and for girls, 6.8 per cent., of the gross weight.

This estimate is considerably larger than that given by Quetelet,* whose allowance for clothing is, for boys, $\frac{1}{8}$ (5.5

* Sur l'Homme, II. p. 44.

per cent.), and for girls, $\frac{1}{24}$ (4.17 per cent.), of the gross weight. This difference is, perhaps, to be in part accounted for by the fact that the pupils whose clothes were weighed were probably rather better clothed than the average children of the same age; for it was, of course, impossible to obtain, by the method adopted, any data from the poorest classes of the population, owing to their lack of an intelligent interest in the matter.

SUMMARY OF RESULTS.

The most important results of the foregoing investigation may be enumerated as follows:—

I. The growth of children takes place in such a way that until the age of eleven or twelve years, boys are both taller and heavier than girls of the same age. At this period of life girls begin to grow very rapidly, and for the next two or three years surpass boys of the same age in both height and weight. Boys then acquire and retain a size superior to that of girls who have now nearly completed their full growth. This statement is based upon observations on several different races and in various conditions of life.

II. Children of American-born parents are, in this community, taller and heavier than children of foreign-born parents, a superiority which seems to depend partly on the greater average comfort in which such children live and grow up, and partly upon differences of race or stock.

III. Pupils of American parentage at the public Latin School, private Latin School, and Massachusetts Institute of Technology are (apparently for similar reasons) superior in height and weight to the generality of boys of American parentage attending the public schools.

IV. Pupils of the same selected schools are also taller and heavier than English boys of the non-laboring classes attending public schools and universities, the superiority in weight being, as a rule, more marked than that in height.

V. The relation of weight to height in growing children is such that at heights below 58 inches, boys are heavier than girls in proportion to their stature. At heights above 58 inches the reverse is the case.

CONCLUSION.

Both the number and the value of the conclusions arrived at in this investigation are diminished by the lack of similar collections of statistics in other communities with which a comparison may be made. This being the case, the following brief enumeration of the points to which the attention of the collector of vital statistics may profitably be directed, will, perhaps, not be considered out of place :—

I. *The influence of geographical and climatic conditions on the size of growing children.*—It has been shown by the researches of Dr. Gould and Dr. Baxter, that the size of adult native Americans is very different in different States of the Union, and even in different parts of the same State. It would be interesting to determine by observations on children how early in life this difference becomes apparent.

II. *The number of generations necessary for the complete development of the influence of changed climatic conditions on the rate of growth of a given race.*—It has already been shown (see p. 299) that this influence apparently begins to be felt in the first generation, and it would be of interest to trace the accumulating effect through successive generations by means of inquiries as to the ancestry of the individuals measured. This could most readily be accomplished in those Western communities which consist almost exclusively of emigrants (and their descendants) from some limited region of the Old World.

III. *The effect (if any exists) of the season of the year on the rate of growth.*—This would be readily ascertained by successive spring and autumn observations on growing children ; and it is in recording measurements of this sort that fathers of families and all others having charge of children have it in their power to contribute most efficiently to the solution of anthropometrical and ethnological questions.

IV. *The comparative effect of city and of country life on the rate of growth.*—In investigating this subject, the effect of climatic influences must be eliminated by restricting the comparison to cities and the *adjacent* country, and regard must be

paid to the race or stock and to the social condition of the individuals selected for comparison.

V. *The relation between diseases and the rate of growth.*—For example, it would be interesting to inquire whether, in the rapid growth which is said to follow certain diseases, especially fevers, the height and weight increase in their normal ratio; whether this accelerated growth *after* the disease is simply a compensation for a retardation *during* the disease; whether abnormally rapid growth causes a predisposition to disease, and whether any connection can be traced between the rate of growth and the frequency with which certain diseases of growing children (*e. g.*, chorea) occur at different ages.

VI. *The effect of local hygienic conditions on the physique of growing children.*—Since comfort and misery appear to have such a direct effect upon the size of growing children, it seems not improbable that a systematic comparative study of the physique of the growing population in different localities will throw light upon the relative sanitary conditions there prevalent.

It will thus be seen that a wide field is open for statistical research, in which nearly every one can do good work. The collection of physical data in regard to the human body has been, in the past, left almost exclusively in the hands of artists, who have sought to establish, as guides for their work, simple proportions between the various dimensions of the body, and of military statisticians, who have looked upon the human frame simply as a machine for performing a soldier's work, and have necessarily confined their observations to adult males. It is to be hoped that in the future the hygienist and the educator will recognize, in the physical measurements of growing children, a guide for the application of their sanitary regulations and a test for the efficiency of their systems of physical training.

A P P E N D I X.

By the kindness of President Runkle of the Massachusetts Institute of Technology, the writer is enabled to present formulas which express the relation between the weight and height of growing children, from five to eighteen years of age, with considerable accuracy.*

The figures of Tables Nos. 23 and 24, showing the weights corresponding to each inch of height in the whole number of observations were placed by President Runkle in the hands of Professor Gaetano Lanza, who kindly subjected them to a mathematical discussion, and reported on the subject substantially as follows :—

The results of Dr. Bowditch's observations on the relation between the weight and height of boys from 42 to 66 inches inclusive, are very fairly represented by the following empirical equation :—

Let y = weight in lbs., and x = height in inches ; then

$$\log. y = 0.02007x + 0.77724, \text{ or } y = 10^{0.02007x + 0.77724}. \quad (A)$$

The results of the observations on the relation between the weight and height of girls from 42 to 61 inches inclusive, are represented with tolerable accuracy by the following empirical equation :—

Let y = weight in lbs., and x = height in inches ; then

$$\log. y = 0.02164x + 0.69017, \text{ or } y = 10^{0.02164x + 0.69017}. \quad (B)$$

The greatest difference between calculated and observed values is, in the case of boys, 0.65 lb., and in that of girls, 1.41 lbs., with one exception, where it is 3.01 lbs.

The equations

$$y = 0.002428x^{2.50} \quad (A^1)$$

for the boys, and

$$y = 0.001277x^{2.75} \quad (B^1)$$

for the girls, represent quite roughly the results.

The following table, embodying the results of Professor Lanza's discussion, shows at a glance the superior accuracy of the logarithmic equations (A) and (B), as compared with the exponential equations (A¹) and (B¹).

* For older as well as for younger children, the formulas are obviously much less accurate.

TABLE NO. 26.

Showing the agreement between the observed weights corresponding to each inch of height, and those calculated by the equations A , A^1 , B , and B^1 .

HEIGHT, in inches.	BOYS—WEIGHT IN POUNDS.					GIRLS—WEIGHT IN POUNDS.				
	Observed.	CALCULATED.				Observed.	CALCULATED.			
		By (A).	Correction.	By (A^1).	Correction.		By (B).	Correction.	By (B^1).	Correction.
42, .	41.77	41.71	+0.06	38.84	+2.93	40.89	39.72	+1.17	37.16	+3.73
43, .	43.60	43.68	−0.08	41.28	+2.32	42.62	41.75	+0.87	39.65	+2.97
44, .	45.63	45.74	−0.11	43.82	+1.81	44.53	43.89	+0.64	42.23	+2.30
45, .	47.58	47.91	−0.36	46.44	+1.11	46.45	46.13	+0.32	44.92	+1.53
46, .	49.65	50.17	−0.52	49.16	+0.49	48.51	48.49	+0.02	47.72	+0.79
47, .	52.07	52.55	−0.48	51.98	+0.09	50.71	50.96	−0.25	50.63	+0.08
48, .	54.57	55.03	−0.46	54.89	−0.32	53.19	53.57	−0.38	53.65	−0.46
49, .	57.31	57.68	−0.32	57.90	−0.59	56.06	56.30	−0.24	56.78	−0.71
50, .	60.20	60.35	−0.15	61.01	−0.81	58.75	59.18	−0.43	60.02	−1.27
51, .	63.23	63.21	+0.02	64.22	−0.99	61.89	62.20	−0.31	63.38	−1.49
52, .	66.27	66.20	+0.07	67.53	−1.26	64.86	65.38	−0.52	66.86	−2.00
53, .	69.20	69.34	−0.14	70.95	−1.75	67.54	68.72	−1.18	70.46	−2.92
54, .	72.73	72.61	+0.12	74.47	−1.74	71.01	72.23	−1.22	74.17	−3.16
55, .	76.44	76.05	+0.39	78.09	−1.65	74.90	75.92	−1.02	78.01	−3.11
56, .	80.24	79.65	+0.59	81.83	−1.59	78.82	79.80	−0.98	81.97	−3.15
57, .	84.04	83.41	+0.63	85.66	−1.22	83.38	83.88	−0.50	86.06	−2.68
58, .	87.86	87.36	+0.50	89.61	−1.75	87.92	88.16	−0.24	90.23	−2.31
59, .	91.58	91.48	+0.10	93.67	−2.09	93.29	92.67	+0.62	94.62	−1.33
60, .	95.51	95.82	−0.31	97.83	−2.32	98.81	97.40	+1.41	99.10	−0.29
61, .	100.54	100.35	+0.19	102.11	−1.57	105.89	102.38	+3.51	103.70	+2.19
62, .	105.63	105.09	+0.54	106.50	−0.87	-	-	-	-	-
63, .	110.71	110.06	+0.65	111.01	−0.30	-	-	-	-	-
64, .	115.86	115.27	+0.59	115.63	+0.23	-	-	-	-	-
65, .	121.01	120.72	+0.29	120.37	+0.64	-	-	-	-	-
66, .	126.61	126.43	+0.18	125.23	+1.38	-	-	-	-	-

TABLE No. 1.—*Showing Average Heights and Weights of Boston School Boys.*
AVERAGE HEIGHTS (without shoes).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	AMERICAN.			IRISH.			AMERICAN AND IRISH.		
	No, of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.
Five, .	201	41.74	106.0	366	41.59	105.5	42	42.16	107.1
Six, .	342	44.10	112.0	503	43.74	111.1	65	43.56	110.7
Seven, .	369	46.21	117.4	562	45.61	115.8	77	45.68	116.1
Eight, .	407	48.16	122.3	588	47.72	121.2	66	47.53	120.7
Nine, .	381	50.09	127.2	556	49.53	125.2	67	49.30	125.2
Ten, .	360	52.21	132.6	571	51.57	131.1	56	51.35	130.4
Eleven, .	350	54.01	137.2	548	53.10	134.9	55	53.33	135.4
Twelve, .	373	55.78	141.7	497	54.82	139.3	53	55.13	140.0
Thirteen, .	391	58.17	147.7	463	56.70	144.0	45	56.69	143.9
Fourteen, .	386	61.08	155.1	334	58.88	149.5	22	59.28	150.5
Fifteen, .	342	62.96	159.9	155	61.15	155.3	16	} 61.93	157.3
Sixteen, .	232	65.58	166.5	61	64.09	162.8	6		
Seventeen, .	128	66.29	168.4	26	} 66.20	168.2			
Eighteen, .	65	66.76	169.5	5					
Totals, .	4,327			5,235			570		

TABLE No. 1 (Continued).—*Showing Average Heights and Weights of Boston School Boys.*
AVERAGE HEIGHTS (without shoes).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.		
	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.
Five, .	48	41.08	104.3	75	41.40	105.2	848	41.57	105.6
Six, .	71	43.50	110.5	99	43.64	110.9	1,258	43.75	111.1
Seven, .	87	45.25	114.1	113	45.60	115.8	1,419	45.74	116.2
Eight, .	84	47.13	119.7	136	47.50	120.7	1,481	47.76	121.3
Nine, .	87	48.85	124.1	130	49.39	125.4	1,437	49.69	126.2
Ten, .	75	51.21	130.1	105	51.62	131.2	1,363	51.68	131.3
Eleven, .	91	52.92	134.4	93	52.81	134.1	1,293	53.33	135.4
Twelve, .	76	54.55	138.6	101	54.89	139.4	1,253	55.11	140.0
Thirteen, .	53	56.70	144.0	84	56.76	144.2	1,160	57.21	145.3
Fourteen, .	38	59.14	151.2	47	59.40	150.9	908	59.88	152.1
Fifteen, .	26	62.06	157.6	51	61.48	156.2	636	62.30	158.2
Sixteen, .	7	} 64.75	164.4	27	63.88	162.2	359	65.00	165.1
Seventeen, .	7			1,061			192	66.16	168.0
Eighteen, .	2						84	66.66	169.3
Totals, .	752						13,691		

TABLE No. 1 (Continued).—Showing Average Heights and Weights of Boston School Boys.
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	AMERICAN .			IRISH.			AMERICAN AND IRISH.		
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.
Five, .	201	41.20	18.71	366	41.33	18.75	42	41.99	19.05
Six, .	342	45.14	20.48	503	45.25	20.52	65	44.73	20.29
Seven, .	369	49.47	22.44	562	48.90	22.19	77	49.08	22.26
Eight, .	407	54.43	24.70	588	54.12	24.55	66	52.86	23.97
Nine, .	381	59.97	26.58	556	58.92	26.73	67	57.27	25.97
Ten,. .	360	66.62	30.22	571	64.99	29.48	56	64.57	29.29
Eleven, .	350	72.39	32.83	548	69.60	31.56	55	70.34	31.91
Twelve, .	373	79.82	36.21	497	75.70	34.34	53	75.66	34.32
Thirteen,. .	391	88.26	40.04	463	82.84	37.58	45	81.42	36.93
Fourteen,. .	386	99.28	45.03	334	91.19	41.36	22	91.89	41.68
Fifteen, .	342	110.84	50.26	155	101.21	45.90	16	} 107.91	48.96
Sixteen, .	232	123.67	56.09	61	112.88	51.19	6		
Seventeen, .	128	128.72	58.40	26	} 127.40	57.80			
Eighteen,. .	65	132.71	60.20	5					
Totals, .	4,327			5,235			570		

TABLE No. 1 (Concluded).—Showing Average Heights and Weights of Boston School Boys.
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .						TOTALS.				
	GERMAN.			ONE OR BOTH ENGLISH.							
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.		
Five, .	48	40.57	18.39	75	40.07	18.18	848	41.09	18.64		
Six, .	71	44.09	20.01	99	45.03	20.43	1,258	45.17	20.49		
Seven, .	87	49.12	22.29	113	48.20	21.86	1,419	49.07	22.26		
Eight, .	84	52.94	24.02	136	53.21	24.14	1,481	53.92	24.46		
Nine, .	87	58.25	26.43	130	58.57	26.58	1,437	59.23	26.87		
Ten, .	75	63.93	29.00	105	65.06	29.51	1,363	65.30	29.62		
Eleven, .	91	69.09	31.34	98	67.11	30.44	1,293	70.18	31.84		
Twelve, .	76	75.70	34.34	101	75.39	34.20	1,253	76.92	34.89		
Thirteen, .	53	83.85	38.04	84	84.72	38.44	1,160	84.84	38.49		
Fourteen, .	38	92.87	42.12	47	92.72	42.07	908	94.91	42.95		
Fifteen, .	26	107.53	48.80	51	101.21	45.90	636	107.10	48.59		
Sixteen, .	7	} 123.67	56.09	27	120.32	54.57	359	121.01	54.90		
Seventeen, .	7								192	127.49	57.84
Eighteen, .	2								84	132.55	60.13
Totals, .	752			1,061			13,691				

TABLE No. 2.—*Showing Average Heights and Weights of Boston School Girls.*
AVERAGE HEIGHTS (without shoes).

AGE AT LAST BIRTHDAY.	P A R E N T A G E.									
	AMERICAN.			IRISH.			AMERICAN AND IRISH.			
	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.	
Five, .	127	41.47	105.3	236	41.18	104.6	29	41.42	105.2	
Six, .	236	43.66	110.9	395	43.29	109.9	43	43.18	109.6	
Seven, .	346	45.94	116.7	426	45.45	115.4	53	45.69	116.0	
Eight, .	338	48.07	122.1	486	47.39	120.4	59	47.40	120.4	
Nine, .	323	49.61	126.0	416	49.27	125.2	48	48.77	123.9	
Ten, .	336	51.78	131.5	379	51.20	130.1	51	51.17	129.9	
Eleven, .	290	53.79	136.6	340	53.13	134.9	36	53.51	135.9	
Twelve, .	309	57.16	145.2	307	55.41	140.8	28	54.91	139.5	
Thirteen, .	307	58.75	149.2	278	57.64	146.3	28	57.81	146.8	
Fourteen, .	290	60.32	153.2	192	59.67	151.5	23	59.44	151.0	
Fifteen, .	255	61.39	155.9	95	60.47	153.5	11	} 61.07	155.0	
Sixteen, .	238	61.72	156.7	49	61.05	155.1	9			
Seventeen, .	168	61.99	157.4	18	} 62.00	157.5				
Eighteen, .	118	62.01	157.5	6						
Totals, .	3,681			3,623			418			

TABLE No. 2 (Continued).—*Showing Average Heights and Weights of Boston School Girls.*
AVERAGE HEIGHTS (without shoes).

AGE AT LAST BIRTHDAY.	P A R E N T A G E.								
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.		
	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.	No. of Obs.	Inches.	Centimeters.
Five, .	50	41.40	105.1	75	41.14	104.5	605	41.29	104.9
Six, .	66	43.09	109.4	98	43.32	110.0	987	43.35	110.1
Seven, .	82	44.91	114.0	104	44.81	113.8	1,199	45.52	115.6
Eight, .	75	47.15	119.7	117	47.63	121.0	1,299	47.58	120.9
Nine, .	76	49.20	125.0	96	49.37	125.4	1,149	49.37	125.4
Ten, .	57	50.76	128.9	112	50.98	129.5	1,089	51.34	130.4
Eleven, .	57	52.62	133.9	88	53.63	136.2	936	53.42	135.7
Twelve, .	53	54.73	139.0	89	55.89	141.9	935	55.88	141.9
Thirteen, .	31	57.82	146.8	69	57.71	146.6	830	58.16	147.7
Fourteen, .	23	58.55	148.7	56	60.15	152.8	675	59.94	152.3
Fifteen, .	10	} 59.81	151.9	48	60.93	154.7	459	61.10	155.2
Sixteen, .	4			27	62.17	157.9	353	61.59	156.4
Seventeen, .	1						233	61.92	157.2
Eighteen, .							155	61.95	157.3
Totals, .	585			979			10,904		

TABLE No. 2 (Continued).—Showing Average Heights and Weights of Boston School Girls.
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .					
	AMERICAN.		IRISH.		AMERICAN AND IRISH.	
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.
Five, .	127	39.82	18.06	236	39.63	17.97
Six, .	236	43.81	19.87	395	43.21	19.60
Seven, .	346	48.02	21.78	426	47.64	21.61
Eight, .	338	52.93	24.01	486	51.80	23.50
Nine, .	323	57.52	26.10	416	56.76	25.75
Ten, .	336	64.09	29.07	379	61.59	27.94
Eleven, .	290	70.26	31.87	340	67.83	30.77
Twelve, .	309	81.35	36.90	307	76.15	34.55
Thirteen, .	307	91.18	41.36	278	85.76	38.91
Fourteen, .	290	100.32	45.50	192	96.36	43.71
Fifteen, .	255	108.42	49.17	95	100.46	45.56
Sixteen, .	238	112.97	51.24	49	108.56	49.24
Seventeen, .	168	115.84	52.54	18	} 115.82	52.49
Eighteen, .	118	115.80	52.52	6		
Totals, .	3,681			3,623		
					418	
						18.42
						19.52
						21.44
						23.21
						24.79
						27.69
						30.85
						33.82
						38.97
						44.37
						49.68

TABLE No. 2 (Concluded).—*Showing Average Heights and Weights of Boston School Girls.*
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.		
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.
Five, .	50	39.73	18.02	75	39.05	17.72	605	39.66	17.99
Six, .	66	42.68	19.36	98	43.26	19.62	987	43.28	19.63
Seven, .	82	46.26	20.98	104	46.26	20.99	1,199	47.46	27.10
Eight, .	75	50.60	22.96	117	52.45	23.79	1,299	52.04	23.44
Nine, .	76	57.37	26.02	96	55.96	25.40	1,149	57.07	25.91
Ten, .	57	59.83	27.14	112	60.98	27.66	1,089	62.35	28.29
Eleven, .	57	67.56	30.65	88	69.78	31.65	936	68.84	31.23
Twelve, .	53	76.06	34.50	89	77.24	35.03	935	78.31	35.53
Thirteen, .	31	85.82	38.93	69	86.38	39.20	830	88.65	40.21
Fourteen, .	23	88.91	40.33	56	98.73	44.78	675	98.43	44.65
Fifteen, .	10	} 101.16	45.87	48	105.53	47.88	459	106.08	48.12
Sixteen, .	4			27	111.94	50.76	353	112.03	50.81
Seventeen, .	1						233	115.53	52.41
Eighteen, .							155	115.16	52.24
Totals, .	585			979			10,904		

TABLE NO. 3.—*Showing Annual Growth and Ratio of Weight to Height of Boston School Children.*
BOYS.

A G E.*	P A R E N T A G E.									
	A M E R I C A N.				I R I S H.				A M E R I C A N A N D I R I S H.	
	A n n u a l I n c r e a s e.			P o u n d s p e r i n c h.	A n n u a l I n c r e a s e.			P o u n d s p e r i n c h.	A n n u a l I n c r e a s e.	
	H e i g h t, i n c h e s.	W e i g h t, p o u n d s.	H e i g h t, i n c h e s.		W e i g h t, p o u n d s.	H e i g h t, i n c h e s.	W e i g h t, p o u n d s.			
Five,	.	2.36	3.94	.987	2.15	3.92	.993	1.40	2.74	.996
Six,	.	2.11	4.33	1.023	1.87	3.65	1.034	2.12	4.35	1.027
Seven,	.	1.95	4.96	1.070	2.11	5.22	1.072	1.85	3.78	1.074
Eight,	.	1.93	5.54	1.130	1.81	4.80	1.134	1.77	4.41	1.112
Nine,	.	2.12	6.65	1.197	2.04	6.07	1.189	2.05	7.30	1.161
Ten,	.	1.80	5.77	1.276	1.53	4.61	1.260	1.98	5.77	1.257
Eleven,	.	1.77	7.43	1.340	1.72	6.10	1.310	1.80	5.32	1.319
Twelve,	.	2.39	8.44	1.431	1.88	7.14	1.381	1.56	5.76	1.372
Thirteen,	.	2.91	11.02	1.517	2.18	8.35/	1.461	2.59	10.47	1.436
Fourteen,	.	1.88	11.56	1.625	2.27	10.02	1.548			1.550
Fifteen,	.	2.62	12.83	1.760	2.94	11.67	1.655			
Sixteen,	.	.71	5.05	1.885			1.761			
Seventeen,	.	.47	3.99	1.941			1.924			
Eighteen,	.			1.988						

* See foot-note, p. 281.

TABLE No. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
BOYS.

A G E . *	P A R E N T A G E .									
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.			
	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	
	Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		
Five, .			.987			.967			.988	
Six, .	2.42	3.52	1.013	2.24	4.96	1.031	2.18	4.08	1.032	
Seven, .	1.75	5.03	1.085	1.96	3.17	1.057	1.99	3.90	1.072	
Eight, .	1.88	3.82	1.123	1.90	5.01	1.119	2.02	4.85	1.129	
Nine, .	1.72	5.31	1.192	1.89	5.36	1.185	1.93	5.31	1.191	
Ten, .	2.36	5.68	1.248	2.23	6.49	1.260	1.99	6.07	1.263	
Eleven, .	1.71	5.16	1.305	1.19	2.05	1.270	1.65	4.88	1.315	
Twelve, .	1.63	6.61	1.388	2.08	8.28	1.373	1.78	6.74	1.395	
Thirteen, .	2.15	8.15	1.477	1.87	9.33	1.492	2.10	7.92	1.482	
Fourteen, .	2.44	9.02	1.570	2.64	8.00	1.561	2.67	10.07	1.585	
Fifteen, .	2.92	14.66	1.732	2.08	8.49	1.646	2.42	12.19	1.719	
Sixteen, .			} 1.952	2.40	19.11	1.883	2.70	13.91	1.861	
Seventeen, .							1.16	6.48	1.927	
Eighteen, .							.50	5.06	1.988	

* See foot-note, p. 281.

TABLE No. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
GIRLS.

AGE.*	PARENTAGE.									
	AMERICAN.					IRISH.				
	AMERICAN AND IRISH.					AMERICAN AND IRISH.				
	Annual Increase.		Pounds per inch.		Height, inches.	Annual Increase.		Pounds per inch.		Height, inches.
	Height, inches.	Weight, pounds.	Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.	Height, inches.	Weight, pounds.	
Five,	.	.	.	.	.	.	.	.	.	.
Six, .	2.19	3.99	.960	3.58	2.11	.962	3.58	1.76	2.43	.980
Seven,	2.28	4.21	1.003	4.43	2.16	.998	4.43	2.51	4.26	.996
Eight,	2.13	4.91	1.045	4.16	1.94	1.048	4.16	1.71	3.89	1.034
Nine,	1.54	4.59	1.101	4.96	1.88	1.093	4.96	1.37	3.49	1.079
Ten, .	2.17	6.57	1.159	4.83	1.93	1.152	4.83	2.40	6.51	1.120
Eleven,	2.01	6.17	1.237	6.24	1.93	1.203	6.24	2.34	6.85	1.195
Twelve,	3.37	11.09	1.306	8.32	2.28	1.276	8.32	1.40	6.53	1.271
Thirteen,	1.59	9.83	1.423	9.61	2.23	1.374	9.61	2.90	11.34	1.357
Fourteen,	1.57	9.14	1.552	10.60	2.03	1.487	10.60	1.63	11.94	1.486
Fifteen,	1.07	8.10	1.663	4.10	.80	1.614	4.10			1.645
Sixteen,	.33	4.55	1.766	8.10	.58	1.661	8.10			
Seventeen,	.27	2.87	1.830			1.778				
Eighteen,	.02	— .04	1.869			1.870				
			1.867							1.793

* See foot-note, p. 231.

TABLE No. 3 (Concluded).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
GIRLS.

A G E . *	P A R E N T A G E .									
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.			
	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	
	Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		
Five, .			.959			.947			.965	
Six, .	1.69	2.95	.990	2.18	4.21	.998	2.06	3.62	.998	
Seven, .	1.82	3.58	1.030	1.49	3.00	1.032	2.17	4.18	1.042	
Eight, .	2.24	4.34	1.073	2.82	6.19	1.101	2.06	4.58	1.093	
Nine, .	2.05	6.77	1.166	1.74	3.51	1.133	1.79	5.03	1.156	
Ten, .	1.56	2.46	1.178	1.61	5.02	1.197	1.97	5.28	1.214	
Eleven, .	1.86	7.73	1.284	2.65	8.80	1.301	2.08	6.49	1.288	
Twelve, .	2.11	8.50	1.393	2.26	7.46	1.382	2.46	9.47	1.401	
Thirteen, .	3.09	9.76	1.484	1.82	9.14	1.497	2.28	10.34	1.524	
Fourteen, .	.73	3.09	1.518	2.44	12.35	1.641	1.78	9.78	1.642	
Fifteen, .			} 1.691	.78	6.80	1.732	1.16	7.65	1.736	
Sixteen, .				1.24	6.41	1.800	.49	5.95	1.819	
Seventeen, .							.33	3.50	1.865	
Eighteen, .							.03	— .37	1.859	

* See foot-note, p. 281.

TABLE No. 2 (Continued).—Showing Average Heights and Weights of Boston School Girls.
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	AMERICAN.			IRISH.			AMERICAN AND IRISH.		
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.
Five, . . .	127	39.82	18.06	236	39.63	17.97	29	40.59	18.42
Six, . . .	236	43.81	19.87	395	43.21	19.60	43	43.02	19.52
Seven, . . .	346	48.02	21.78	426	47.64	21.61	53	47.28	21.44
Eight, . . .	338	52.93	24.01	486	51.80	23.50	59	51.17	23.21
Nine, . . .	323	57.52	26.10	416	56.76	25.76	48	54.66	24.79
Ten, . . .	336	64.09	29.07	379	61.59	27.94	51	61.17	27.69
Eleven, . . .	290	70.26	31.87	340	67.83	30.77	36	68.02	30.85
Twelve, . . .	309	81.35	36.90	307	76.15	34.56	28	74.55	33.82
Thirteen, . . .	307	91.18	41.36	278	85.76	38.91	28	85.89	38.97
Fourteen, . . .	290	100.32	45.50	192	96.36	43.71	23	97.83	44.37
Fifteen, . . .	255	108.42	49.17	95	100.46	45.56	11	} 109.51	49.68
Sixteen, . . .	238	112.97	51.24	49	108.56	49.24	9		
Seventeen, . . .	168	115.84	52.54	18	} 115.82	52.49			
Eighteen, . . .	118	115.80	52.52	6					
Totals, . . .	3,681			3,623			418		

TABLE No. 2 (Concluded).—*Showing Average Heights and Weights of Boston School Girls.*
AVERAGE WEIGHTS (in ordinary dress).

AGE AT LAST BIRTHDAY.	P A R E N T A G E .								
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.		
	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.	No. of Obs.	Pounds.	Kilograms.
Five, .	50	39.73	18.02	75	39.05	17.72	605	39.66	17.99
Six, .	66	42.68	19.36	98	43.26	19.62	987	43.28	19.63
Seven, .	82	46.26	20.98	104	46.26	20.99	1,199	47.46	27.10
Eight, .	75	50.60	22.96	117	52.45	23.79	1,299	52.04	23.44
Nine, .	76	57.37	26.02	96	55.96	25.40	1,149	57.07	25.91
Ten, .	57	59.83	27.14	112	60.98	27.66	1,089	62.35	28.29
Eleven, .	57	67.56	30.65	88	69.78	31.65	936	68.84	31.23
Twelve, .	53	76.06	34.50	89	77.24	35.03	935	78.31	35.53
Thirteen, .	31	85.82	38.93	69	86.38	39.20	830	88.65	40.21
Fourteen, .	23	88.91	40.33	56	98.73	44.78	675	98.43	44.65
Fifteen, .	10	} 101.16	45.87	48	105.53	47.88	459	106.08	48.12
Sixteen, .	4			27	111.94	50.76	353	112.03	50.81
Seventeen, .	1						233	115.53	52.41
Eighteen, .							155	115.16	52.24
Totals, .	585			979			10,904		

TABLE No. 3.—*Showing Annual Growth and Ratio of Weight to Height of Boston School Children.*
BOYS.

A G E.*	P A R E N T A G E.									
	A M E R I C A N.			I R I S H.			A M E R I C A N A N D I R I S H.			
	A n n u a l I n c r e a s e.			A n n u a l I n c r e a s e.			A n n u a l I n c r e a s e.			
	Height, inches.	Weight, pounds.	Pounds per inch.	Height, inches.	Weight, pounds.	Pounds per inch.	Height, inches.	Weight, pounds.	Pounds per inch.	
Five,	.	.	.987	2.15	3.92	.993	1.40	2.74	.996	
Six, .	.	.	1.023	1.87	3.65	1.034	2.12	4.35	1.027	
Seven, .	.	.	1.070	2.11	5.22	1.072	1.85	3.78	1.074	
Eight, .	.	.	1.130	1.81	4.80	1.134	1.77	4.41	1.112	
Nine, .	.	.	1.197	2.04	6.07	1.189	2.05	7.30	1.161	
Ten, .	.	.	1.276	1.53	4.61	1.260	1.98	5.77	1.257	
Eleven, .	.	.	1.340	1.72	6.10	1.310	1.80	5.32	1.319	
Twelve, .	.	.	1.431	1.88	7.14	1.381	1.56	5.76	1.372	
Thirteen, .	.	.	1.517	2.18	8.35	1.461	2.59	10.47	1.436	
Fourteen, .	.	.	1.625	2.27	10.02	1.548			1.550	
Fifteen, .	.	.	1.760	2.94	11.67	1.655			1.742	
Sixteen, .	.	.	1.885			1.761				
Seventeen, .	.	.	1.941							
Eighteen, .	.	.	1.988			1.924				

* See foot-note, p. 281.

TABLE No. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.

BOYS.

P A R E N T A G E .										
A G E . *	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.			
	Annual Increase.			Annual Increase.			Annual Increase.			
	Height, inches.	Weight, pounds.	Pounds per inch.	Height, inches.	Weight, pounds.	Pounds per inch.	Height, inches.	Weight, pounds.	Pounds per inch.	
Five,	.	.	.987	2.24	4.96	.967	2.18	4.08	.988	
Six, .	.	.	1.013	1.96	3.17	1.031	1.99	3.90	1.032	
Seven,	.	.	1.085	1.90	5.01	1.057	2.02	4.85	1.072	
Eight,	.	.	1.123	1.89	5.36	1.119	1.93	5.31	1.129	
Nine,	.	.	1.192	2.23	6.49	1.185	1.99	6.07	1.191	
Ten, .	.	.	1.248	1.19	2.05	1.260	1.65	4.88	1.263	
Eleven,	.	.	1.305	2.08	8.28	1.270	1.78	6.74	1.315	
Twelve,	.	.	1.388	1.87	9.33	1.373	2.10	7.92	1.395	
Thirteen,	.	.	1.477	2.64	8.00	1.492	2.67	10.07	1.482	
Fourteen,	.	.	1.570	2.08	8.49	1.561	2.42	12.19	1.585	
Fifteen,	.	.	1.732	2.40	19.11	1.646	2.70	13.91	1.719	
Sixteen,	.	.	} 1.952	.	.	1.883	1.16	6.48	1.861	
Seventeen,50	5.06	1.927	
Eighteen,	1.988	

* See foot-note, p. 281.

TABLE No. 3 (Continued).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
GIRLS.

AGE.*	PARENTAGE.									
	AMERICAN.				IRISH.				AMERICAN AND IRISH.	
	Annual Increase.			Pounds per inch.	Annual Increase.			Pounds per inch.	Annual Increase.	
	Height, inches.	Weight, pounds.			Height, inches.	Weight, pounds.			Height, inches.	Weight, pounds.
Five,	.	.	.960				.962			
Six, .	2.19	3.99	1.003		2.11	3.58	.998		1.76	2.43
Seven,	2.28	4.21	1.045		2.16	4.43	1.048		2.51	4.26
Eight,	2.13	4.91	1.101		1.94	4.16	1.093		1.71	3.89
Nine,	1.54	4.59	1.159		1.88	4.96	1.152		1.37	3.49
Ten, .	2.17	6.57	1.237		1.93	4.83	1.203		2.40	6.51
Eleven,	2.01	6.17	1.306		1.93	6.24	1.276		2.34	6.85
Twelve, .	3.37	11.09	1.423		2.28	8.32	1.374		1.40	6.53
Thirteen, .	1.59	9.83	1.552		2.23	9.61	1.487		2.90	11.34
Fourteen, .	1.57	9.14	1.663		2.03	10.60	1.614		1.63	11.94
Fifteen, .	1.07	8.10	1.766		.80	4.10	1.661			
Sixteen, .	.33	4.55	1.830		.58	8.10	1.778			
Seventeen, .	.27	2.87	1.869				1.870			
Eighteen, .	.02	— .04	1.867							

* See foot-note, p. 231.

TABLE No. 8 (Concluded).—Showing Annual Growth and Ratio of Weight to Height of Boston School Children.
GIRLS.

AGE.*	P A R E N T A G E .									
	GERMAN.			ONE OR BOTH ENGLISH.			TOTALS.			
	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	Annual Increase.		Pounds per inch.	
	Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		Height, inches.	Weight, pounds.		
Five, .			.959			.947			.965	
Six, .	1.69	2.95	.990	2.18	4.21	.998	2.06	3.62	.998	
Seven, .	1.82	3.58	1.030	1.49	3.00	1.032	2.17	4.18	1.042	
Eight, .	2.24	4.34	1.073	2.82	6.19	1.101	2.06	4.58	1.093	
Nine, .	2.05	6.77	1.166	1.74	3.51	1.133	1.79	5.03	1.156	
Ten, .	1.56	2.46	1.178	1.61	5.02	1.197	1.97	5.28	1.214	
Eleven, .	1.86	7.73	1.284	2.65	8.80	1.301	2.08	6.49	1.288	
Twelve, .	2.11	8.50	1.393	2.26	7.46	1.382	2.46	9.47	1.401	
Thirteen, .	3.09	9.76	1.484	1.82	9.14	1.497	2.28	10.34	1.524	
Fourteen, .	.73	3.09	1.518	2.44	12.35	1.641	1.78	9.78	1.642	
Fifteen, .			} 1.691	.78	6.80	1.732	1.16	7.65	1.736	
Sixteen, .				1.24	6.41	1.800	.49	5.95	1.819	
Seventeen, .							.33	3.50	1.865	
Eighteen, .							.03	— .37	1.859	

* See foot-note, p. 281.

TABLE No. 4.—Showing 1

INCHES.											No.
	5 Yrs.		6 Yrs.		7 Yrs.		8 Yrs.		9 Yrs.		
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	
74, . . .	—	—	—	—	—	—	—	—	—	—	—
73, . . .	—	—	—	—	—	—	—	—	—	—	—
72, . . .	—	—	—	—	—	—	—	—	—	—	—
71, . . .	—	—	—	—	—	—	—	—	—	—	—
70, . . .	—	—	—	—	—	—	—	—	—	—	—
69, . . .	—	—	—	—	—	—	—	—	—	—	—
68, . . .	—	—	—	—	—	—	—	—	—	—	—
67, . . .	—	—	—	—	—	—	—	—	—	—	—
66, . . .	—	—	—	—	—	—	—	—	—	—	—
65, . . .	—	—	—	—	—	—	—	—	—	—	—
64, . . .	—	—	—	—	—	—	—	—	—	—	—
63, . . .	—	—	—	—	—	—	—	—	—	—	—
62, . . .	—	—	—	—	—	—	—	—	—	—	—
61, . . .	—	—	—	—	—	—	—	—	—	—	—
60, . . .	—	—	—	—	—	—	—	—	—	—	—
59, . . .	—	—	—	—	—	—	—	—	1	.0	—
58, . . .	—	—	—	—	—	—	—	—	2	.1	—
57, . . .	—	—	—	—	—	—	—	—	1	.0	—
56, . . .	—	—	—	—	—	—	2	.13	4	.2	—
55, . . .	—	—	—	—	—	—	1	.07	7	.4	—
54, . . .	—	—	—	—	—	—	9	.61	24	1.6	—
53, . . .	—	—	—	—	—	—	6	.40	61	4.2	—
52, . . .	—	—	—	—	2	.14	24	1.62	113	7.8	—
51, . . .	—	—	—	—	7	.43	55	3.71	186	12.9	1
50, . . .	—	—	1	.07	18	1.27	123	8.31	252	17.5	3
49, . . .	—	—	7	.55	60	4.23	197	13.30	289	20.1	5
48, . . .	—	—	22	1.74	105	7.40	274	18.50	219	15.2	10
47, . . .	4	.47	47	3.73	202	14.24	303	20.46	163	11.3	21
46, . . .	8	.94	96	7.63	270	19.03	225	15.20	73	5.0	44
45, . . .	20	2.35	170	13.51	270	19.03	150	10.13	27	1.8	70
44, . . .	62	7.31	253	20.19	251	17.69	71	4.79	8	.5	75
43, . . .	119	14.03	260	20.66	126	8.88	32	2.16	3	.2	68
42, . . .	149	17.57	219	17.40	71	5.00	2	.13	1	.0	50
41, . . .	190	22.40	100	7.94	24	1.69	3	.20	1	.0	35
40, . . .	149	17.57	60	4.76	10	.70	2	.13	1	.0	11
39, . . .	79	9.31	14	1.11	2	.14	—	—	1	.0	11
38, . . .	42	4.95	7	.55	—	—	1	.07	—	—	—
37, . . .	17	2.00	1	.07	—	—	1	.07	—	—	—
36, . . .	7	.82	1	.07	1	.07	—	—	—	—	1
35, . . .	1	.12	—	—	—	—	—	—	—	—	—
34, . . .	—	—	—	—	—	—	—	—	—	—	1
33, . . .	—	—	—	—	—	—	—	—	—	—	1
32, . . .	—	—	—	—	—	—	—	—	—	—	—
31, . . .	—	—	—	—	—	—	—	—	—	—	—
30, . . .	1	.12	—	—	—	—	—	—	—	—	—
Totals, .	848		1,258		1,419		1,481		1,437		407

age.

									POUNDS.
Yrs.	15 Yrs.		16 Yrs.		17 Yrs.		18 Yrs.		
Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	
-	-	-	-	-	-	-	-	-	218 to 222
-	-	-	-	-	-	-	-	-	214 to 218
-	-	-	-	-	-	-	-	-	210 to 214
-	-	-	-	-	-	-	-	-	206 to 210
-	-	-	-	-	-	-	-	-	202 to 206
-	-	-	-	-	-	-	-	-	198 to 202
-	-	-	-	-	-	-	-	-	194 to 198
-	-	-	-	-	-	-	-	-	190 to 194
-	-	-	-	-	-	-	-	-	186 to 190
-	-	-	-	-	-	-	-	-	182 to 186
-	-	-	-	-	-	-	-	-	178 to 182
-	-	-	-	-	1	5.55	-	-	174 to 178
-	-	-	-	-	-	-	-	-	170 to 174
-	-	-	-	-	-	-	-	-	166 to 170
-	-	-	-	-	-	-	-	-	162 to 166
-	-	-	-	-	1	5.55	-	-	158 to 162
-	-	-	-	-	-	-	-	-	154 to 158
.52	-	-	1	2.04	-	-	-	-	150 to 154
1.04	-	-	-	-	-	-	-	-	146 to 150
-	1	1.05	-	-	1	5.55	-	-	142 to 146
.52	-	-	1	2.04	-	-	-	-	138 to 142
.52	2	2.10	1	2.04	-	-	-	-	134 to 138
-	2	4.21	2	4.08	-	-	-	-	130 to 134
1.04	-	-	2	4.08	1	5.55	-	-	126 to 130
1.56	4	4.21	1	2.04	2	11.11	-	-	122 to 126
1.56	-	-	5	10.20	-	-	-	-	118 to 122
3.12	3	3.16	3	6.12	-	-	-	-	114 to 118
6.25	8	8.42	3	6.12	4	22.22	2	33.33	110 to 114
8.85	8	8.42	5	10.20	5	27.77	1	16.66	106 to 110
8.33	15	15.80	5	10.20	2	11.11	1	16.66	102 to 106
10.93	13	13.68	10	20.41	1	5.55	1	16.66	98 to 102
10.93	9	9.47	5	10.20	-	-	1	16.66	94 to 98
11.45	9	9.47	2	4.08	-	-	-	-	90 to 94
8.33	6	6.31	1	2.04	-	-	-	-	86 to 90
6.77	8	8.42	1	2.04	-	-	-	-	82 to 86
12.00	2	2.10	-	-	-	-	-	-	78 to 82
1.56	2	2.10	1	2.04	-	-	-	-	74 to 78
1.56	3	3.16	-	-	-	-	-	-	70 to 74
1.56	-	-	-	-	-	-	-	-	66 to 70
1.04	-	-	-	-	-	-	-	-	62 to 66
.52	-	-	-	-	-	-	-	-	58 to 62
-	-	-	-	-	-	-	-	-	54 to 58
-	-	-	-	-	-	-	-	-	50 to 54
-	-	-	-	-	-	-	-	-	46 to 50
-	-	-	-	-	-	-	-	-	42 to 46
-	-	-	-	-	-	-	-	-	38 to 42
-	-	-	-	-	-	-	-	-	34 to 38
-	-	-	-	-	-	-	-	-	30 to 34
	95		49		18		6		

DISEASE OF THE MIND.

BY CHARLES F. FOLSOM, M. D.,
SECRETARY OF THE BOARD.

- I.—EARLY TREATMENT OF THE INSANE.
 - II.—PINEL'S REFORM AND EUROPEAN PROGRESS.
 - III.—ENGLISH PROGRESS AND CONOLLY.
 - IV.—AMERICAN PROGRESS.
 - V.—MODERN METHODS OF LESS RESTRAINT.
 - VI.—RESPONSIBILITY FOR CRIME AND DEFINITIONS OF INSANITY.
 - VII.—MASSACHUSETTS STATISTICS AND ASYLUM ACCOMMODATION.
 - VIII.—SUPERVISION BY THE STATE.
 - IX.—CERTAIN ASYLUM NEEDS.
 - X.—MEDICAL EDUCATION.
 - XI.—SUMMARY.
-
-

DISEASE OF THE MIND.*

"Other nations are making rapid progress; and if the States are to keep before them, or even to keep up with them, they must be anxiously looking around for suggestions, and ready to adopt improvements from all quarters."—*President McCosh in the International Review, March, 1874.*

"It is manifest, that if we would hope to keep our institutions up to the recent level of those of England and France and Germany, it must be done by unremitting activity, by never being satisfied with present attainments, and by keeping the community well advised of the absolute necessity of liberal means to meet this great end."—*Dr. Luther V. Bell's Report for 1853.*

EARLY TREATMENT OF THE INSANE.

It is impossible to get any fair idea of the present status of the insane † and their treatment without reviewing briefly the history of the subject. Mental aberration has, of course, existed in some form from the earliest times. The ancient Egyptians had temples ‡ dedicated to Saturn (Seb) in charge

* This term (on the whole, the least objectionable) is used as signifying a certain morbid condition of the brain, whereby the cerebral functions are impaired to a sufficient degree to seriously interfere with the ordinary relations of life, or render them impossible. Of course this "certain morbid condition" was arbitrarily limited in its application when little was known of the subject; it is meant to exclude a similar state of the mental, moral and emotional faculties often observed in many of the common fevers and other diseases.

The writer desires to express his indebtedness to Rev. W. C. Gannett, Dr. D. F. Lincoln, and Dr. A. H. Nichols, for many valuable suggestions and criticisms in their careful revision of the manuscript or proof, and to Dr. Edward Jarvis for the use of his library of rare pamphlets, reports, etc., in preparing this paper. Several hundred books, pamphlets, reports, etc., have been consulted; but no attempt is made to give a bibliography of the subject, which, indeed, would constitute a large volume by itself. If any desire to pursue their investigations farther, the references in the text and in the foot-notes will probably be sufficient for their purpose.

† The discussion of the subject here will be confined within its strictly practical limits. Those portions, therefore, which relate to the causes, prevalence, increase, prevention, etc., have been necessarily omitted, as involving a minute examination of statistics, and as demanding a separate consideration by themselves.

‡ It is well known that the Greeks and Romans treated the sick, and probably some of the insane, too, in rooms adjoining their temples.

of priests, who "cured" the insane by amusement, occupation and healthful habits chiefly, but with the pretended exercise of spiritual influence. In the early Greek writers, and in the Old Testament, we find delineations of mental disease, and in the later Greek tragedians, but without any apparent appreciation of its true character. The physicians were mystics: some of them recommended hellebore from Mount Cæta, and others extolled that of Galatia or Sicily. Hippocrates first had a fair conception of the real nature of insanity, and treats of it, although briefly, on more rational principles. Some of his disciples had very clear ideas of its treatment by medical and moral means; but the Hippocratic oath bound them to a secrecy which prevented their knowledge from becoming at all general. Asclepiades, although differing with Hippocrates in many points of theory, had essentially the same views with regard to the nature of mental disease,—its dependence on bodily conditions, and its treatment by remedial agents. Plato thought that there were two forms of mania,—one of purely corporeal origin, and one an inspiration from the gods.

The first insane asylum of which we have any definite knowledge was built by the monks at Jerusalem, in the sixth century, for their fellows whose reason had given way under the austere penances which had produced a St. Jerome and a St. Simeon Stylites. This was about two centuries after the establishment of the first public hospital, which was built by a Roman lady as a penance and a gift to her native city.

In the seventh century, the insane began to make pilgrimages to the shrine of St. Dymphna * at Gheel, near Antwerp, in the hope that they would there find restoration to health. In time quite a colony of them grew up, living in the houses of the peasants, to which others of the insane were sent, because they could be cheaply cared for there. Later still, it was taken in charge, and in 1851 organized by the State, still keeping up the daily visit to St. Dymphna's tomb, without

* An Irish girl who fled thither to escape from a cruel father, and whose persecutions, when followed and found by him, became famous. We have become familiar, recently, with a similar movement in the "miraculous appearance" at Lourdes in France, and in the annual pilgrimages to that place.

which the benefits from air, exercise and employment were thought of little account.

At Fez, several asylums existed in the seventh century. At the beginning of the fourteenth century, one was built at Cairo, and Lecky thinks that "it is probable that the care of the insane was a general form of charity in Mohammedan countries." *

Among Christians, the first in Western Europe was founded by a monk in Valencia in 1409, and the same century saw the establishment of four others in Spain. The Moors were undoubtedly in advance of the Christians at this time in all matters relating to health; † and Desmaisons gives them the credit of this movement in Spain. An insane asylum was opened in Utrecht ‡ in the fifteenth century, which remained in private hands until 1834. In the middle of the sixteenth century, the Spaniards erected an insane asylum in Rome, the year after the old hospital, now represented by Bethlehem § ("Bedlam"), was opened in London, and about a century before the first || in Paris.

During the two centuries following the establishment of the first asylum in Spain, the monks, who were the principal depositaries of medical knowledge, had the care of the insane in convents in Europe. Their treatment was, with few exceptions, ignorant and barbarous, until St. Vincent de Paul travelled from land to land proclaiming that the darkened mind, which was at that time looked upon and treated as if possessed by evil spirits, was just as much a visitation from God as the darkened eyesight. The Franciscan monks used then to whip daily those under their charge,—a means of discipline which, indeed, they used also upon themselves; and it would be idle to guess how many were burned, put to the rack, etc.,

* History of European Morals, II., p. 94.

† Seventh Report of the State Board of Health, p. 276.

‡ A Visit to Thirteen Asylums for the Insane in Europe. By Pliny Earle, M. D., Philadelphia, 1841. Institutions for the Insane in Prussia, Austria, and Germany. By Pliny Earle, M. D., Utica, 1853.

§ This was founded in 1246 as one of the religious houses of the Order of Bethlehem. When these houses were suppressed in the time of Henry VIII., it became a small insane asylum for the corporation of London, although the insane had been known to be received there for at least the previous century and a half. It was rebuilt in 1675, and again in 1814. The first medical attendant was appointed in 1632.

|| This was really only a department of the Hôtel Dieu, where three or four were sometimes placed in one bed.

under the theory of witchcraft and devilcraft. The Knights of Malta, at that time, received the insane with the other sick in their hospitals.

In 1751, a few benevolent gentlemen in London established the first asylum in modern times (St. Luke's) for the care of the insane exclusively. From the first, there were separate wards for the curable and for the incurable.

At the very close of the last century, there were three corporate asylums and one public in the United States, and five public in England. The private asylums were also very few, that of the parson-doctor, Willis, in England, being the most celebrated. In fact, the reputation of Willis was so great that he was called to attend King George the Third in his second attack of mental disease in 1788. His treatment of even so exalted a personage was arbitrary and dogmatic in the extreme. Mechanical restraint was liberally used, and the strait-jacket was one of the common means of "discipline." In his own asylum it must have been the same, although for his more quiet patients he was in advance of his day, and depended to some extent on an excellent table, regular habits, general good health and agreeable occupation; but he allowed his attendants to beat the more unruly * when they thought it necessary.

The age was one of the most absolute dogmatism; but insanity and the phenomena of mind were thought to belong to the province of the theologian and the metaphysician, and their dogma was even more narrow than that of the doctors.

Neither Hoffmann, Stahl nor Boerhaave had advanced the knowledge of insanity. Cullen in Scotland and Morgagni in Italy had begun accurate observations; but not until John Hunter went to London, in 1748, was the inductive method of study in medicine fairly inaugurated, and he was so far in advance of his time that he never had an audience of twenty persons in all the years of his lecturing. Although he was "a man, who, for comprehensive and original research, comes immediately after Adam Smith, and must be placed far above any other philosopher whom Scotland has produced," † his principle of careful deductions from recorded facts had

* This was also permitted by the regulations of "Bedlam."

† Buckle's History of Civilization, II., p. 432.

not been generally adopted in medicine, and nowhere had it been applied to the study of the mind. The regular physicians did not study mental diseases in the schools, and Warren and his illustrious compeers in London looked upon Willis, with his enormous fees, as only a charlatan.

During the last quarter of the past century, the insane, when not entirely neglected, were almost universally confined in jails and poorhouses, and, of course, in chains. In Scotland, a farmer, "as large as Hercules," had a reputation for curing them by his severity. In England, the practice of making several hundred pounds a year, by exhibiting the inmates of Bethlehem Hospital to the populace for a small fee, was given up only in 1770. In France, asylums were considered only as receptacles for chronic cases, where the attendants (often convicts serving out their time) were allowed to whip them. Van Helmont had recommended sudden plunging of the insane into cold water and keeping them there for some moments, and that remedy was still used. In this country the treatment was no better. The Spaniards alone, according to Pinel,* especially in the asylum at Saragossa, where the inscription *urbis et orbis* was placed over the door, had a rational open-air treatment.

It does not come within the scope of this paper to enter fully into the humiliating records of that age, nor to discuss the reasons why the intelligent views of the Egyptians, Greeks and Romans, so utterly lost in the darkness of the Middle Ages, did not reappear upon the revival of learning or during the splendid Elizabethan age.

With their religion, the Hebrews transmitted to the Christians of Europe their demon-theory of insanity; and it was considerably less than a century ago that the insane began again, by the efforts of Willis, Pinel, Tuke, Chiaruggi, Reil, Langermann and Rush, to be treated as sick people. Then, as Roller says, *wurden die verlorenen Menschenrechte wieder gewonnen*† (the lost rights of humanity were regained).

Up to that time no one had described the phenomena of mental disease so accurately as Shakespeare; no one its pathology and treatment better than Goethe.

* *Traité médico-philosophique sur l'aliénation mentale.* Paris, 1801, p. 250.

† *Psychiatrische Zeitfragen aus dem Gebiet der Irrenfürsorge,* Berlin, 1874.

PINEL'S REFORM AND EUROPEAN PROGRESS.

France.

The Duc de La Rochefoucauld, Tenon, and a few others in Paris took the first steps in the reform of the treatment of the insane which marks the present centenary, a matter to which their attention had been called by John Howard in his visit to Europe in 1780; but Pinel was the great man in that work. He was appointed by the government to examine and report on the asylums at Paris and Charenton;* and afterwards, in 1792, when a mature physician in middle life, and a member of the Royal Academy, he became superintendent of the Bicêtre, the asylum for incurable males. Later still Salpêtrière, where the female insane were confined, was placed under his charge. The events of the revolution had filled the wards with the most excited cases. They were usually sent first to Hôtel Dieu, the general hospital, where they were bled, purged, and douched, and then afterwards to the insane asylum, if they were thought incurable. The asylum was not looked upon as a hospital, a place of cure.

As soon as Pinel received his appointment, he repeatedly asked the Commune to allow him to remove the chains from all who wore them, or one-fourth of those confined. The idea was to them preposterous; but finally, tired out with his importunity, they allowed Couthon to go with him to see what could be done. After looking over the patients, he said to Pinel, "*Ah, ça! citoyen, es-tu fou toi-même de vouloir déchaîner de pareils animaux?*" (citizen, are you crazy yourself that you would unchain such animals?) He persisted, however, removed the chains from fifty-three persons in three days, beginning with that one who had been thought the most desperate, and sought to give them occupation, making one his servant, interesting others in attending to those more needing care than themselves, etc.,—apparently getting the hint from Thouin, of the insane asylum at Amsterdam, who employed the quiet inmates in taking care of others, as was then the custom generally in Holland. Pinel kept constantly before him his independent motto, "*Chercher à éviter toute*

* Then established about a half-century.

*illusion, toute prévention, toute opinion adoptée sur parole** (to seek to avoid all illusion, all prejudice, all opinion taken on authority). He still, however, held the strait-jacket (*gilet de force*) in high repute; and although he was the first in modern times to adopt the "moral treatment"† in a public asylum, his practice may be inferred from his choosing large and muscular men for his attendants.

Pinel knew almost nothing of pathology. He read Hippocrates, Aretæus, Galen and Celsus. The contemporary medical writers and their theories he cared little about. He believed chiefly in careful observation of the insane themselves, and never for a moment countenanced the force, deception and ingenious tricks of surprise and terror in such general use at that time. Cullen, with his theory of three forms of insanity,—(1) mental, (2) corporeal, (3) of obscure origin,—he regarded as simply a little above the rest of the theorists. The German writers, generally, he considered as even less practical than the English and Scotch; but excepts Greding, whose two hundred careful autopsies he speaks of with approbation as praiseworthy efforts, although denying that any relation could be established between post-mortem appearances and intellectual derangements observed during life. His knowledge of psychology he got chiefly from Condillac, Montaigne, Locke, Harris, Smith and Stewart. He had only five classes of mental disease: (1) melancholia, simple, or complicated with hypochondriasis; (2) mania without delirium or incoherence; (3) mania with delirium; (4) dementia; (5) idiocy. Still, even in this, he was in advance of his time; for, according to the Vienna school, there were only two divisions: (1) maniacal delirium, and (2) melancholic delirium.

The reform was slow in its advances. Following Greding in Berlin, Pinel made careful autopsies and dissections and examinations of the brain; but these were fragmentary bits of evidence until Bichat appeared,‡ the greatest investigator and

* A full account of this great work, by Pinel's son, may be found in the *Mémoires de l'Académie Royale de Médecine*, Tome V.

† This term has been used since Pinel's day to indicate amusement, occupation, and all generally elevating influences.

‡ His *Anatomie Générale* was published in 1801, and the *Recherches Physiologiques* in 1800.

generalizer of his age, whose researches and experiments in anatomy and physiology make an epoch in the history of science, and after whom came Louis and modern medicine based upon exact observation. One of his pupils, Esquirol, advanced the pathology of mental disease as Pinel had advanced its treatment. He visited the colony of the insane at Gheel,* with his students, in 1821, and opened a discussion as to its merits, which was continued in nearly all the languages of Europe. Upon his return to Paris he established the farm in connection with the Bicêtre, which Pinel had attempted without success. He also devoted much attention to asylum construction, and for years after his time his plan of a large rectangular block with a court in the centre was the one adopted. His *Maladies Mentales*, published in 1838, and based upon an experience of forty years at Charenton and in the Salpêtrière, may be referred to for a full description of the history† of asylums in France. In Esquirol's private institution for the insane (each one of whom had an attendant) the quiet patients dined with his family; the others were treated with a free use of the strait-jacket.

Many years after Pinel's death, chains were in common use in the treatment of the insane on the continent of Europe outside of the great university cities, and in Great Britain; but the work of careful research went on, while the laboratories of Berlin, Paris, and later, Vienna, were busy with scalpels and reagents. The doctors were still disputing whether insanity were an affection of an immaterial mind or of the material brain; whether it arose from disease or vice.

Germany.

The first German asylum for the custody of the insane alone was ready to receive patients in Vienna in 1784. Its name, the *Narrenthurm* (fools' tower), gives a fair idea of the views

* Without entering upon the merits and faults of Gheel, or the question of the propriety of hiring out a helpless class to ignorant peasants, there can be no doubt that Griesinger was right in saying that the experiment has proved that the greater number of the insane do not require the confinement of an asylum; that many of them can be safely trusted with more liberty than these institutions allow, and that association in the family life is very beneficial to many patients. A good account of Gheel may be found in the *Revue des Deux Mondes* for January, 1857.

† In general terms this presents nothing distinctive, farther than those portions already referred to.

of its founders. Practices continued there which had been abandoned in "Bedlam" a dozen years before.

About the beginning of this century, insanity began to be looked upon as curable in Germany, the Saxons taking the lead. They published the first journal exclusively devoted to psychological medicine, in 1805, and appointed Heinroth their first professor of that branch at Leipsic in 1811. The psychic theory of insanity was then universally accepted by them, and Langermann was their acknowledged leader.

Langermann's project of asylums for the insane, embodying many excellent features, was adopted at Sonnenstein, under Pienitz, and soon after at Waldheim and Colditz. These two men and Heinroth developed Pinel's treatment, with which they had become familiar. Their ideas may be inferred from the fact that Heinroth, who wrote a treatise on mental hygiene, thought that all insanity began in vice, and that Langermann said, "God only knows whether an insane person can be cured or not,"—an opinion which he afterwards modified.

When insanity began to be generally looked upon as curable by the medical profession in Germany, asylums for the cure (*heil-anstalten*) as well as for the custody (*pflege-anstalten*) of the insane were established. Unfortunately, from motives of economy or from necessity, the two were soon united in practice, at first by having the two classes in separate buildings under one head, and later by placing both under one roof. From 1820 to 1849, fourteen more asylums were erected.

The psychic theory held its ground pretty well until the time of Griesinger, although shaken by Jacobi in Germany and Van der Kolk in Holland, both of whom did service in calling attention to the more material and practical ideas of the countrymen of John Hunter and of Bichat. The professorship of psychology was established in Berlin about 1830, and the word *seelenstörung* (psychical disorder), as applied to insanity, gradually gave way to *geisteskrankheit* (disease of the mind), thus indicating something of a step forward as more clearly recognizing the purely physical character of the malady.

The great advance of this age was made by Griesinger,

who, when twenty-two years old (1839), was an assistant physician in one of the asylums of Germany. His distinguished services for the following twenty-nine years, to the time of his death, well earned for him his title of the "greatest of modern alienists." Like Pinel, he was not, in the narrow sense, a specialist, for his contributions to general medicine alone would have rendered him famous. He first established the diagnosis of diseases of the mind upon an exact basis and by logical, methodical processes, a work in which he got great assistance from his illustrious contemporary, Virchow, the acknowledged head of the medicine of the present day as based upon scientific research and sound pathology, and as great in his time as John Hunter and Bichat were during the last half of the past and at the beginning of the present century.

In 1845, Griesinger strongly recommended the introduction of the clinical study of mental disease in the schools; but, at Tübingen, where he was then lecturing, he had not facilities for carrying out his design. He began this kind of clinical instruction at Zürich in 1864, as had then already been done at Erlangen, Würzburg, Munich and Göttingen. The same step was taken in Berlin* in 1865, by Ideler, whom Griesinger succeeded in the following year as professor of psychological medicine and physician to the department for the insane in the Charity Hospital.

At the present time, in the study of the physiology and pathology of the brain, based upon exact research,† Germany stands easily first; and the great universities of Berlin and Vienna, under Westphal and Meynert, take the lead in a work where there are so many distinguished investigators that it would be useless to try to even name them all.

Most of the improvements in hospital-construction in Germany have come from England and the United States; but, just as the first permanent "American hospital" (the small separate buildings found so successful during our late war) was built in Germany, so is German science now constructing

* In Vienna, also, about the same time.

† It is not possible to consider this subject here, or to discuss the opposing theories held by Hitzig and Brown-Séquard. The present position of scientific men on this point may be found in articles by Prof. H. P. Bowditch in the *Boston Med. and Surg. Journal*, July 20 and 27, 1876; and in the *British Med. Journal*, Dec. 2, 1876.

the first insane asylum* which embodies the present knowledge of the subject.

ENGLISH PROGRESS AND CONOLLY.

In 1796, four years after Pinel's great reform, a Quaker layman, William Tuke, abolished the chains of the insane in his part of the world, in building the "Retreat" at York, England.

After Pinel and Tuke, the next great step in advance was made by Conolly, a mature English physician of forty-five; but, in order to understand his work, and the peculiar need in England of such work, it will be necessary to review the history of mental disease in that country, although very briefly. A full account may be found in the reports of the parliamentary commissions of 1807, 1815, 1827 and 1844.

In 1815 patients were chained to the walls of the best asylum in London; at Fonthill, thirteen out of fourteen were in chains or handcuffs, and in another asylum there was one towel to 170 patients. In 1822, in some counties, jails were converted into asylums for the insane without change of structure, and were so used as late as 1842. In 1827, at Bethnal Green, with its 500 patients, some were chained to their cribs and confined from Saturday evening till Monday morning, in order to give the attendants their Sunday holiday. No physician or surgeon was in charge, but an apothecary visited two or three times a week.

The first commission† to look after pauper lunatics was appointed in 1828, and that for the metropolis of London only. Up to that time, the only Act in force enabled any two justices to cause them to be apprehended and to be locked up in some secure place "and there chained"; and if the pauper's settlement should prove to be in another parish, then he was to be forwarded thither, and "locked up and chained" by the justices of that district.

In 1828 twelve counties in England had provided asylums.

* See Professor Westphal's letter, page 379.

† The origin and duties of the office of Lord Chancellor's Visitor are so admirably given in Dr. Bucknill's letter at a subsequent page, that only a reference to it is needed here.

for the insane, although the law requiring them was passed in 1808. Six more had been built in 1841. Many of them had no physician in attendance; in nearly all mechanical restraint and coercion were used to a great extent; and the only inspection got by those outside of London was from irregular, uncertain, and often infrequent visits of magistrates or local officials, who were interested in keeping the taxes as low as possible. In the private asylums there was no inspection, and in the jails little better than none.

From 1829 to 1831 over one-half of the patients at Ringmer were in restraint at once. In 1837* many of the worst faults existed in asylums, and few had the confidence of the public; but it would be unfair to imply that there were not others where there were employment and other moral means of treatment, and tranquil wards, where strangers might ask with the statesman Burke, after his visit to a modern asylum, "Where are the insane?" as he thought he had seen none such.

Coleridge probably gave the sentiment of the educated people of the time, and the doctors followed him rather than he the doctors. He says:† "Madness is not simply a bodily disease. It is the sleep of the spirit with certain conditions of wakefulness; that is to say, lucid intervals. During this sleep, or recession of the spirit, the lower or bestial states of life rise up into action and prominence. It is an awful thing to be eternally tempted by the perverted senses. The reason may resist—it does resist—for a long time; but too often, at length, it yields for a moment and the man is mad forever. An act of the will is, in many instances, precedent to complete insanity. I think it was Bishop Butler who said that he was all his life struggling against the devilish suggestions of his senses, which would have maddened him if he had relaxed the stern wakefulness of his reason for a single moment. . . . When a man mistakes his thoughts for persons and things, he is mad. A madman is so defined."

By 1840 there were many private asylums in London, and, in that year, it was found necessary to enact a law making it a

* *What Asylums Were, Are, and Ought To Be.* By W. A. Browne, Surgeon Superintendent of the Montrose Asylum, Edinburgh, 1837.

† *Table Talk*, 1830 and 1832.

misdemeanor for a superintendent of any of them to keep a patient concealed from the commissioners for the metropolis. In 1842 there were 162 asylums, including those of a private class, and the abuses were so great and so frequent that the Lunacy Commission (previously the Metropolitan Commission, above referred to), composed of twenty leading men, of whom seven were physicians, was appointed in that year to visit "all places throughout the kingdom in which persons alleged to be of unsound mind are confined." They were required to visit, one physician and one lawyer together, the licensed houses in the metropolis four times a year; other licensed houses, twice a year; and county asylums, jails, and workhouses, once a year. It would be difficult to overestimate the good which they have done in advancing the knowledge of their specialty and in improving asylums directly in England, and indirectly throughout the civilized world.

In 1847 there were 177 county asylums, hospitals, and licensed houses, 437 separate establishments for single patients, and 596 workhouses, the inspection of which by the local authorities was very unsatisfactory. Six of the asylums had been visited twice in twenty months; eight, three times; nine, four times; and one not for two years. The evasions of the laws had been so numerous that a special Act had been passed in 1845, allowing the commissioners to enter and examine the asylums by night.

It is not necessary to enter into details, or to narrate particular instances. Enough has been said to show that a third of a century ago the condition of the insane in England was such as to demand some radical change.

Conolly's Work.

Conolly's interest in mental disease began while he was a student, and his graduating thesis was on that subject. He early gained a high reputation, and was called to a professorship of clinical medicine in London, but his chief interest was in diseases affecting the mind.* His attention was especially directed to the needs of the insane in England by the work

* A Memoir of John Conolly, M. D., D. C. L., by Sir James Clark, Bart., London, 1869.

of R. Gardiner Hill, of the Lincoln Asylum. He learned that there, in 1830, an aggregate of 27,113 $\frac{3}{4}$ hours had been spent in mechanical restraint by 39 of the 92 patients; and that in 1838, with a largely increased number of inmates, namely, 158, not one had been put in restraint during the whole year. He heard, too, that this change in treatment had been adopted because the very means used to restrain the patients had been the direct cause of the death of two of them.

Hill had become so unpopular with other physicians and with the officials, by reason of this innovation, that he was compelled to resign his position; and it is probable that the movement would have stopped there, had it not been taken up by a man who, like Pinel, thought independently, carried out his honest convictions, and did his work well.

As soon as Conolly was appointed superintendent at Hanwell (in 1839), he visited the Lincoln Asylum, at the request of one of his trustees, who had formerly held the same position there, and introduced the non-restraint system, a course which was even disapproved by the Lunacy Commission; but, in sixteen years, he could say that he was often unable to show his classes any extremely violent cases, whereas, in 1840, the asylum was full of them. He did not suppose, however, that mechanical restraint could be dispensed with in all cases and under all circumstances with benefit to the patient, as he testified in the trial of *Hill v. Phelps*. His system has spread over all England, and at a later day over Scotland, sometimes by the pressure of the Lunacy Commission against the wishes of the superintendent, and occasionally, it must be acknowledged, with some immediate bad results, but with ultimate good.

One of Conolly's admirers says of him: "It appears to me that the fact that the principles laid down by him have been almost universally accepted and acted upon by a generation to whom he was personally unknown, is a far higher testimony to the sagacity of his judgment, than the adhesion to his views of those, who, knowing him well, were influenced by his lofty enthusiasm and by the persuasive eloquence of his teachings." *

* Address of the President of the British Medico-Psychological Association, by Dr. T. L. Rogers, 1874.

Meyer and Griesinger have introduced the non-restraint system in Germany, Van der Kolk in Holland, and Morel in France; but it has not yet been entirely adopted in either of those countries.

In 1854 the English commissioners say: "Asylums were formerly constructed as if violence were the rule in the condition of the lunatics. They are now constructed as if it were the exception; and it is the exception." Since that date, great advances have been made in that country, which will be referred to at a later page.

AMERICAN PROGRESS.

In this country, the province of Pennsylvania was the first to recognize its duties to the insane. Some benevolent persons, headed by Dr. Bond, took steps in Philadelphia in 1750 to establish "a small provincial hospital." In 1751 the Legislature passed an "Act to encourage the establishing of a hospital for the relief of the sick poor of this province, and for the reception and care of lunatics," a considerable portion of the money being subscribed by private individuals. In February, 1752, the first patients were received in the hospital (extemporized out of a private dwelling), of whom three of the first four admitted were insane. In the first two years, eighteen suffering from the "disease lunacy" were admitted, of whom two were cured. The trustees complained, in their first report, that many were taken away by friends before the cure was established, and passed a resolve "to admit none hereafter who are not allowed to remain twelve months in the house, if not cured sooner, or judged by the physicians to be incurable." As there had been considerable opposition to the project on the part of some members of the Legislature, on the ground of expense, the visiting physicians gave their services, and at first charitably supplied the medicines prescribed by them.* The insane were kept in cells in the basement of the building until 1796.†

Dr. Benjamin Rush returned from his three years' visit and

* An Address on the Occasion of the Centennial Celebration of the Founding of the Pennsylvania Hospital, delivered June 10, 1851, by Geo. B. Wood, M. D.

† A separate building was erected and occupied in 1841, now, in many respects one of the finest in the world.

study in Europe in 1769. He began his visits to the insane in the hospital in 1783, treating them, in the main, with doses and bleedings, as he did his other patients, but still as sick people.* He of course knew little of exact science, and at that time nothing of the "moral treatment." His "Diseases of the Mind," for which we are indebted to this hospital's experience, is, according to Dr. Isaac Ray,† "the first of the kind in the English tongue, displaying thorough observation and original thought." Rush, the "American Sydenham," is well called by Dr. Bowditch, in his centennial address at Philadelphia, one of the most noteworthy men of the past centenary, although essentially a medical-system maker. He soon saw the wrong of the whips and chains in use in the treatment of the insane in his time, and gave them up for other; namely, "mild and terrifying modes of punishment." He thought it important, upon being called to see a patient suffering from mental disease, "to look him out of countenance." He recommended low diet, consisting of vegetables only, bleeding, purging, emetics, blisters, salivation, darkness, cold baths, etc. Up to the time of his death, in 1813, there were four cells in the hospital "so formed that it was possible to make them dark with but little trouble." In the later years of his professorship, he introduced the moral treatment of Pinel to some extent, and speaks of the advantages of music, employment, etc., although he did not give up his other remedies for the more violent cases.

In 1773 the first state asylum in this country was established in Williamsburg, Virginia (including Kentucky, which was not made a separate State till 1792), Mr. James Galt having been appointed keeper, an office which he retained forty-nine years. The Act of the General Assembly, in 1769, stated the desired end to be for "effecting a cure of those whose cases are not become quite desperate, and for restraining others who may be dangerous to society." Dr. Sigueyra was appointed visiting physician when the asylum was opened. The first resident physician and superintendent, Dr. John M. Galt, Jr., was appointed in 1841.

In 1769, Dr. Samuel Bard, in an address delivered in

* Some Account of the Pennsylvania Hospital, Philadelphia, 1817.

† Contributions to Mental Pathology, p. 6.

Columbia (then King's) College, New York, "so warmly and pathetically set forth" the need of a general hospital, that a subscription was at once set on foot, aided by friends in England. A building begun in 1773 was nearly destroyed by fire in 1775, and the war of the Revolution prevented its completion before 1791, when it was opened for general diseases. In 1797, two cases of mania were admitted, but, as one is reported as having died there in the same month, there must have been previous admissions, although there is no record of them. A separate hospital for the insane was finished in 1808, with the help of the Legislature; and in 1821 the still better Bloomingdale Asylum took its place.*

The "Maryland Hospital," the next in order, organized by two physicians, was established in Baltimore in 1797 for general diseases and insanity. It was enlarged in 1807, and remained a private institution until 1864. In 1828, the late Dr. R. S. Steuart was appointed visiting physician and president. Since 1836 there has been also a resident physician. In 1828 the hospital was organized for the exclusive treatment of the insane.

In connection with the recent steps in England to introduce more refining influences in their male wards by having female attendants, one portion of Dr. Steuart's work is of especial interest; namely, his exclusive employment of female attendants as early as 1835, even in the male wards. Rush had called attention in 1812† to the fact that the insane in Java, who were able to do so, employed female attendants, and that under their "mild and soothing influence" the proportion of recoveries was large, but that treatment had not been adopted elsewhere.

We began the century with four asylums, of which only one had been built entirely by the State. Private institutions were almost unknown, and the few that existed were only better than the jails and poorhouses, where many of the insane were kept.

In 1813, some Friends in Philadelphia called the attention of their community to Tuke's work in England, and, the next

* History, Description and Statistics of the Bloomingdale Asylum for the Insane. By Pliny Earle, M. D., Physician to the Institution.

† Medical Inquiries and Observations upon Diseases of the Mind, p. 178.

year, published "The Account of the Rise and Progress of the Asylum, with an Abridged Account of the Retreat, near York, in England." After having purchased fifty-two acres of land at Frankford, near the city, they got money and began building a hospital, which was opened in 1817, that the insane might see that they were "regarded as *men* and *brethren*." A resident physician was appointed, and, although a great deal of restraint was the rule, the patients did all the work on the farm. "Whether the symptoms were mild or severe, treatment the most soothing and gentle was uniformly extended." In receiving patients, preference was given to recent cases, of which three were cured in the first year; there were nineteen admissions. In 1824, as some uneasiness was expressed lest the rule at this hospital, requiring security for the payment of damages done to the glass and furniture by the patients, should operate as a discouragement to the applications for admission, the trustees thought best to state that "the whole amount of charges of this nature against the patients, during the seven years since the asylum was opened, is \$30.19 on account of glass broken, and \$27.17 for damages done to furniture."* Their example induced the giving up of chains, etc., at the State Asylum of Kentucky in 1826.

In establishing the McLean Asylum at Somerville, adapted from a private residence, in 1818,† just three years after the opening of the Harvard Medical School in Boston, Massachusetts was the fifth of our States to provide for their insane. In their address to the public in 1814 and 1816, the trustees dwell on the curability of insanity and the importance of its proper treatment.

The founding of this asylum marks an important era in the history of mental disease in this country. It established the character and principles of treatment which have become

* Trustees' Reports for 1818 and 1824.

† Thomas Hancock left some money to the town of Boston for a small-pox hospital and lunatic asylum, between 1760 and 1770, and there were two more legacies in 1797 and 1798 by Thomas Boylston and William Phillips. In 1810, Drs. Jackson and Warren appealed to the public so successfully that the Massachusetts General Hospital was chartered by the Legislature in the following year. In 1816, after the depression caused by the war of 1812, 1,047 persons subscribed to one or both departments of the hospital. John McLean, by his noble donation in 1821, gave to the asylum his name.

universal with us, and especially the principle of state supervision. The trustees were men of broad views and high character. Part of them being appointed by the governor, the State has thus exercised constant supervision over the interests of the patients. In nearly sixty years, their faithful and careful weekly visits to the asylum have been only once omitted.* In advance of the usual practice at that time, too, a resident medical superintendent was appointed, Dr. Rufus Wyman, whose reports one need only read to appreciate how well he was fitted for this, a pioneer's work.

From October 1, 1818, to December 31, 1821, he reports 121 patients discharged, of whom 32 were cured; 28 remained. In 1822, he says,† "In this part of the country the disease had been generally believed to be incurable;" "it is too true that such treatment [whips, chains, etc.] in time not long past, has been approved and often advised by medical men. An entire revolution of opinion respecting the treatment of lunatics has been produced"; "kindness and humanity have succeeded to severity and cruelty." The estimation in which the community held the asylum may be inferred from Dr. Wyman's observation, that for the chronic insane "the establishment has been considered a comfortable winter residence, where the boarders would enjoy the benefits of apartments well warmed, well ventilated, and free from the dangers of fire."

In speaking of Dr. Wyman's work, Dr. Bell said, in 1843, "To this day scarce any institution can be visited in the land where evidences of the operations of his mind do not present themselves on every hand."

The "Retreat" at Hartford, Conn., a corporate asylum like the McLean, and the State Asylum of Kentucky, were opened in 1824. The Kentucky Asylum was simply "for the comfort and safe-keeping of persons of unsound mind," as stated in the Act. It was adapted from a building intended for an ordinary hospital (the Fayette). As the patients were put under the charge of a keeper, with the paraphernalia of hand-

* History of the Massachusetts General Hospital, by Nathaniel I. Bowditch, with a continuation by George E. Ellis, D. D.

† Report to the Trustees, pp. 24, 25, 27 and 28.

cuffs, shackles, strait-jackets,* etc., the word "comfort" in the Act could not have been used in its ordinary sense. There was no medical care until 1844, when a physician was appointed superintendent.

Virginia with its second asylum, and North Carolina with its first, followed in 1828. In 1830, Massachusetts founded the Worcester Asylum "for the safe-keeping of lunatics and those furiously mad" in the words of the Resolve of the Legislature, at last accepting the noble words of one of her most far-sighted legislators, the late Horace Mann, that the insane are the wards of the State, a principle which has become that on which all civilized nations now attempt to act. The hospital was open for patients in 1833.

The other States of this country followed: Vermont in 1836; Ohio in 1838; Maine in 1840; the first state asylum in Pennsylvania in 1841; New Hampshire, Georgia, and the State Asylum in Maryland in 1842; the first public asylum in New York in 1843; Rhode Island in 1845; Indiana in 1847; New Jersey, Louisiana and Illinois in 1848; Tennessee in 1849; Missouri in 1851; California in 1853; Mississippi in 1855; North Carolina in 1856; District of Columbia in 1858; Michigan in 1859; Wisconsin in 1860; Alabama, Iowa and Texas in 1861; the first state asylum in Connecticut in 1864;† Kansas in 1866; West Virginia in 1867; Minnesota in 1870; Nebraska in 1871; and Oregon a few years later. The first asylum for the former slaves of our Southern States was established out of an impoverished treasury by Virginia, in 1870, using a hospital formerly occupied by the Freedmen's Bureau. It will be remembered that Virginia was the first of our States to build a public insane asylum.

At the present time we have (1876) sixty-eight public asylums, accommodating, including those not yet occupied, about 30,000 patients. Dr. Conrad gives a list of nineteen private and corporate hospitals (not including those which are quite small), with a capacity for about 2,600 patients. This number, 32,600, is probably from one-half to three-fifths of our total number. There are probably considerably less than

* Insanity in Kentucky, by Edward Jarvis, M. D.; Boston Medical and Surgical Journal, 1841, p. 165.

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200 in all the private asylums of the United States.* Fifty-five of these state asylums, accommodating 27,000 patients, cost \$29,879,258.†

Many of these asylums were built by the States almost wholly through the efforts of Miss Dix, whose philanthropic labors, begun a third of a century ago, have been the means of many great advances in the comfort of a helpless class, both in this country and in Europe. She visited the poor-houses and county jails, finding her way into hidden corners and tearing official tape, against obstacles which would have daunted a less heroic spirit; and thus thoroughly informed of her subject, she appealed so eloquently to our Legislatures, that many an asylum has been the direct work of her hand and brain. Her frequent visits to our institutions for the

On page 346, line 5, for North, read South.

FOR ABOUT TWENTY YEARS, REPRESENTED roughly by the period when Dr. Bell was in charge of the McLean Asylum, and until about twenty years ago, this country in its state asylums was in advance of Europe. Dr. Browne of Edinburgh, in his lectures on "What Asylums Ought To Be," said in 1837, "in some parts of America there appears to be an ample realization of all that I have wished to inculcate as necessary to place the lunatic in that condition which is most conducive to his happiness and recovery." Writing in 1841, Dr. Edward Jarvis said, "most of the American asylums are doing more for the cure of insanity than any others in the world."

* It is impossible to more than guess at the number of the insane in nearly all of our States. By the United States census of 1870, for instance, there were 1,625 insane in Illinois, whereas the State Board of Charities found 2,376; and of these, only 721 were in both lists. The United States census of 1870 makes the number of the insane in Massachusetts as 2,662, and the idiotic 778, whereas the state census of 1875 makes the numbers respectively 3,637 and 1,340, which is probably not so far from the truth as the former number. By the census of 1860, the insane in the United States numbered 23,999, but Dr. Pliny Earle estimated their real number at 40,000. By the same census, the insane in Massachusetts were stated to be 2,105, although Dr. Edward Jarvis had found, five years previous, that there were 2,632 insane, and 1,087 idiots.

† Insanity; Its Financial Relations to the States, with Statistics. By J. S. Conrad, M. D., Resident Physician to the Maryland Hospital for the Insane, 1876.

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Period of American Leadership.

For about twenty years, represented roughly by the period when Dr. Bell was in charge of the McLean Asylum, and until about twenty years ago, this country in its state asylums was in advance of Europe. Dr. Browne of Edinburgh, in his lectures on "What Asylums Ought To Be," said in 1837, "in some parts of America there appears to be an ample realization of all that I have wished to inculcate as necessary to place the lunatic in that condition which is most conducive to his happiness and recovery." Writing in 1841, Dr. Edward Jarvis said, "most of the American asylums are doing more for the cure of insanity than any others in the world."

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In 1838, Dr. Isaac Ray published his "Medical Jurisprudence of Insanity," a book far in advance of Casper, Esquirol and Marc, and one which, after having passed through several editions, is still the first authority in the English language. It is not claiming too much for our country to say, that the great advance in the social position and legal status of the insane during the last third of a century has been due more to the teachings of our distinguished countryman than to any other one person.

A pleasant picture of the asylum life at Somerville in 1839, just after Dr. Wyman's death, is thus given by Dr. Lee, his successor: "The patients rise and dress about half an hour before breakfast, which is at sunrise in the winter and at six o'clock in the summer. After breakfast they are taken out to walk or ride, or are engaged, as far as possible, in useful labor, as farming, sawing and splitting and piling wood, or assisting their attendants; and a few are engaged in mechanical employment. A large number are occupied more or less in the amusements of bowling, quoits, throwing the ring, and in checkers, chess, backgammon, and other games; and in the interval of these amusements, reading books from the library, newspapers, and writing serve to fill up the time. After tea they are assembled in the oval room for family worship, which consists in reading a chapter from the Bible, singing two hymns, and a prayer. . . . Our quiet and convalescent patients are also taken with us to church, to visit places of interest and amusement, are taken into our family, dine at our table, and sit in our parlors. . . . Personal restraint is in no case made use of except with those disposed to tear clothing or other property, and with the vicious to prevent injury to themselves or others. The number is always small who require any personal restraint."

In 1841, Dr. Ray was appointed medical superintendent of the Maine State Asylum, at a time when Conolly had fairly begun his great work in England, and Miss Dix was going through the poorhouses, jails, etc., of this country to call the attention of our Legislature to the deplorable condition of the insane. Dr. Ray's reports, especially that of 1844, give a fair view of the treatment of mental disease in our state asylums about that time.

Dr. Luther V. Bell was then superintendent at the McLean Asylum, Dr. Thomas S. Kirkbride at the Pennsylvania Hospital, Dr. Samuel B. Woodward at the Massachusetts Asylum in Worcester,* Dr. Pliny Earle at the Bloomingdale Asylum in New York, Dr. William M. Aul at the Ohio State Asylum, Dr. Amariah Brigham at the New York State Asylum, where, in 1844, he established the *American Journal of Insanity*, the first in the English language on that subject,† and which started with the position that insanity is purely a physical disease. Dr. Edward Jarvis had begun his statistical researches, and Dr. Samuel G. Howe was at the height of a career which has deservedly given him the name of the Massachusetts philanthropist.

These were all marked men, who exercised a great influence, and whose work has been as various as their talents. Dr. Bell and Dr. Woodward were men of wide general information, and eminently fitted for a work requiring breadth of grasp, keen observation, sound judgment, and independent action. Dr. Kirkbride devoted himself to hospital construction with a zeal and practical sagacity which made the American asylums of that day absolutely without rivals. His work "*On the Construction, Organization, and General Arrangement of Hospitals for the Insane*" (1854) is still thought by the Association of American Superintendents to cover the whole ground. Dr. Earle and Dr. Jarvis have placed our social and vital statistics of insanity on a par with those of any country. Dr. Aul was chiefly interested in the provision for the insane by the State, in which he did excellent work. Dr. Brigham gave his fine intellect to combating the old idea, then prevalent to a great extent even among doctors, that there can be a disease of an immaterial mind independent of its physical organs. Several years before (in 1832) he had published a treatise on the *Influence of Mental Cultivation on Health*, in which he defined insanity as a disease

* His kindly relation to his patients is illustrated by the fact that in taking the census of 1840, the deputy marshal says there were so many lunatics "in the family of Samuel B. Woodward, in Worcester."

† The *Zeitschrift für Psychiatrie* was first published in 1845; The *Annales Médico-Psychologiques* in 1844; The *Annales d'Hygiène Publique et de Médecine Légale* in 1829; The *Quarterly Journal of Mental Disease* (London) in 1852. There were several short-lived journals in Germany much earlier, the first in 1783.

"produced by morbid excitement of some portions of the brain." Dr. Ray was without a rival in jurisprudence and the phenomena of mental disease.

In 1844, also, three years after a similar society was formed in England, Dr. Ayl, Dr. Kirkbride, and Dr. Woodward organized the Association of Medical Superintendents of American Institutions for the Insane; the first meeting was held in Philadelphia the same year.*

American Principles of Treatment.

Our medical treatment, too, was at least not behind the age. In fact, bleeding, as a remedy in insanity, was very uncommon in this country some time after it continued in general use in England. Our knowledge of hospital hygiene was shown by Dr. Bell's address on that subject in 1848, an essay which would do credit to a much later day. Our "moral treatment" is testified to by the following extracts from reports of that time:†—

"In a word, we endeavor always to treat our patients as every honorable, well-bred man treats another in the common intercourse of society."

"Generally speaking, the more they (the insane) are suffered to act like other men, the more they will strive to become like them."

"The idea of improving the mental faculties of rational people by confining them together in large numbers, without any means of bodily or mental exercise, would be not more absurd, than that of expecting to restore the minds of the insane by a similar treatment. Until recently, however, it was universally supposed, in practice at least, that the insane are incapable of any occupation but that of amusement. It was thought unsafe to trust them with edge-tools, and supposed that they had too little control of their delusions or passions to be able to work to any advantage. It was reserved for

* History of the Association of Medical Superintendents of American Institutions for the Insane, by John Curwen, M. D., Secretary, 1875.

† Probably this description of an English asylum in 1841 could not have been applied to any of ours at any time during the present century. Out of 530 patients, 29 "were wearing either hand-cuffs, leg-locks, or strait-waistcoats, exclusive of between 30 and 40 patients who were chained down during the daytime on seats so constructed as to answer all the purposes of water-closets, in rooms known by the appellation of 'warm-rooms'; moreover, during the nighttime all the epileptic and violent patients were chained or otherwise secured in bed. It was also an established custom to place every case, on admission, under restraint during the nighttime for a longer or shorter period as might appear expedient." (From the report of the lunatic asylum for the county of Lancaster for 1841.)

our own generation to establish the truth, that useful labor is safe, practicable, interesting, and remedial to a large portion of the insane. And why should it not be so? The most of them have their bodily powers unimpaired, and their minds being deranged only on certain subjects, may feel no less interest than ever in some form of industry, nor less ability to engage in it personally."

"Of the eighty-two patients that have been in the hospital in the course of the year, we find that fifty-one have worked regularly almost every day, and a few others have labored occasionally."
—*Dr. Isaac Ray, 1841.*

"Of all the remedies [for mental disease], none can compare with labor, wherein I include all useful employment. No other moral means is adapted to so large a proportion of the insane, and applicable to so many of the various forms of the disease. . . . In most highly excited patients the surplus nervous energy will be consumed, if no other way is provided, in mischief and noise; but let it be expended in useful labor, and, although the work may not always be perfectly done, yet the patient thinks it is, and he experiences that kind of gratification which springs from the consciousness of having done a good thing, and consequently, so far as it goes, is a sound and laudable feeling. This feeling the guardian of the insane cannot too carefully watch over and foster, for it directly leads to an increase of self-control and self-respect. Indeed, many a patient will refrain, for the first time, from destroying his clothing or abusing his attendants on being allowed the privilege of going to work. . . . Even some of the most demented will be found capable of doing something, and though it may not be very profitable, yet it keeps them out of mischief, and contributes to the quiet of the house. . . . While writing this, there is not a single patient in this institution with any kind of restraint upon the person; and this is often the case for many days together. Occasionally, the number under restraint may amount to four or five, but probably the number would not average more than two or three."—*Dr. Isaac Ray, 1844.*

"The application of the severe measures reported as discarded at Hanwell, never was heard of in our asylums,* and but a few even of the measures deemed so insignificant as to form no exception, have ever been found necessary here."†—*Dr. Bell, 1840.*

"Each year that I have passed in this extensive field has served to diminish my confidence in an active medical treatment of almost every form of disease of the mind, and to increase my reliance on moral means. . . . The practice of bleedings, violent purga-

* Dr. Bell refers to our state and corporate asylums only.

† Speaking of New England institutions after a visit to England.

tions, emetics, vesicatories, and derivatives, has passed away before the light of experience. A different and opposite mode of treatment by energetic sedatives, I am satisfied, is obnoxious to many objections, although far to be preferred to the last. . . . A wise expectation and a cautious use of medical agents to meet symptoms, comprise most of the aids that the pharmacopœia is capable of affording. But in relation to the moral means, especially carried through as they can be only by the instrumentality of an appropriate institution, my annual experience has only exalted my confidence."

"The general law, both as regards the curative treatment, or custodial comfort, is constant but varied occupation of body and mind. To ensure this requires every opportunity and aid of labor and amusement. The more perfect the system of an institution, the more ample will be the provision to secure these ends."—*Dr. Luther V. Bell, 1842.*

"Fortunately, in this country there never have been in the institutions any abuses, nor, under the thorough system of governmental inspection which all our public establishments have secured to them, is it scarcely possible that there ever can be any abuses in this regard requiring that the feelings of the community shall be propitiated by the affectation of disusing all forms of mechanical restraint."—*Dr. Bell, 1843.*

Speaking of the McLean Asylum, Dr. Bell says: "For some years the average number of patients under the restraint of leathern mittens has not exceeded one per cent. [per year], and often week after week elapses without even a single instance."

In 1847, Dr. Bell says, "a number of mantel-pieces and open fires have been arranged in the Belknap ward to the greatest comfort and satisfaction of its occupants." In 1848, he says, "personal restraint, as in some preceding years, has been used only in two cases, where the necessity could not be avoided without risk to the patient"; in 1849, as in 1850, it was used in only two or three cases, and "all other forms of mechanical restraint [except the Wyman bed-strap] have been abandoned with us for a number of years, and with no reason thus far to regret their disuse."*

"The executive officers of this institution have gradually abandoned the most exceptional forms of restraint, and more rarely

* Report for 1849, p. 19.

resorted to those of a milder character. They have never, however, become proselytes to the doctrine of the absolutely entire disuse of all restraining apparatus. There are exceptions to all rules which are not governed by the invariable law of mathematics or of moral right, and no argument, however subtle or specious, or, to appearances, however strongly based, theoretically, upon benevolence, philanthropy, kindness, and the golden rule of 'doing to others as we would, under similar circumstances, that they should do unto us,' can overthrow our belief founded upon the observation of several years, that there are cases in which the welfare of the patient and the dictates of true humanity require a resort to some restraining means. . . . There was one period of thirteen months during which restraint was resorted to but in two cases in the men's department. In one of these, the patient, while in a condition of typhoid delirium, wore a camisole three days; and in the other, the patient's hands were similarly confined a few hours, to ensure the vesication of a blister."—*Dr. Earle's report, 1848.*

With all this, the excited insane were found by a committee of our Legislature, in 1848, to be at the Worcester Asylum even in small rooms, "having the least advantages for light, none for ventilation, unfavorably located, dark, dreary, damp and uncomfortable to that extent as to aggravate rather than to assist the cure of the unfortunate beings placed there"; the male violent insane at the McLean Asylum, then considered one of the best, were kept in stone cells in the cellar; and this simply indicates the general knowledge of the time. The position and condition of the more quiet of the insane in asylums were very much better, of course; but it was reserved for further study and experience to show that the most violent may be treated to a certain extent in a similar way.

Later Progress.

In 1863, six years before the establishment of our first State Board of Health, Dr. Ray published the first systematic treatise in the English language on mental hygiene.* How far the community, and indeed the medical profession, were from being ready for it, may be judged from the fact that in thirteen years the first edition has not been sold.

In 1869, the Willard Asylum for the Chronic Insane was opened at Ovid, N. Y. It had long been a problem in all

* Others had been printed under this title, but were really not such.

countries to provide for this large and helpless class at moderate cost; many plans and theories had been suggested; the Gheel system, with all its faults, had been recommended; the village system of Scotland had been praised; but all ended in our building expensive asylums for a favored few, and leaving the rest of the chronic insane to lead miserable lives in county receptacles. In many respects, Dr. John B. Chapin, the medical superintendent at Willard, has succeeded in solving this difficult problem better than has been the case elsewhere. Beside his central buildings, he has three groups of brick cottages, each accommodating 200 patients, and built at a cost of \$100,000 each, or \$500 per patient. The furniture cost \$8,000 for each group. They have the advantage of using the common laundry, etc., and it was not necessary to buy land; but these additional expenses would not amount to more than \$50 per patient. The asylum was visited by the writer, December 8, 1876, and found to contain all that is necessary for the comfort of the patients. The separation of them from one another, even to this extent, had the effect of diminishing noise and excitement. Of course, a medical officer resides in the central building of each group.

The building, "A," was constructed for a school, but has been adapted to the purposes of a separate department for women. "B" is the workshop. The weekly cost of maintaining each patient is a trifle less than three dollars. The accompanying map is reproduced from Dr. Chapin's by his kind permission.

In the same year, 1869, an important step was taken by Dr. John P. Gray of the New York State Asylum at Utica. Recognizing the great advances in knowledge, and the immense field opened in all departments by the introduction of the microscope, he appointed a special pathologist, Dr. Hun, to make investigations in the morbid anatomy of the brain. Dr. Gray's example was followed the year after at Middletown, Conn., in the appointment of Dr. Edward C. Seguin of New York as pathologist to the State Asylum.

In 1870, upon the recommendation of the superintendent, Dr. Bemis, the trustees of the Worcester Asylum appointed a woman as assistant physician in the female department,—an experiment which was followed in the Maine State Asylum in



1911



1873. Upon the resignations of these two ladies, a few years later, it was difficult to find thoroughly educated women, the experiment had not proved altogether satisfactory, and men were appointed to the vacant places. But in the future, when there are accomplished female physicians to fill such posts, as there are now in other branches of medicine, our State can claim to have taken the step in advance.

Great changes have been made in old asylums; and the personal comfort of the patients is more and more an object of solicitude from year to year. At Dr. Kirkbride's, in Philadelphia, "during the past seven years, at one department (*i. e.*, the ladies' wing), for nine months of each year, there has never been a single evening in which there was not some form of entertainment, occupation or amusement. . . . A few attempts to introduce mechanical occupations among women have seemed to me quite successful enough to justify a moderate extension of them. . . . Whatever has banished a delusion from the mind of a patient for a single hour, has done a work whose value is not easily calculated."*

Of the Massachusetts State Asylum at Northampton, in the year ending October, 1874, Dr. Earle reports that there were only twenty-one days in which there was no gathering of the patients in the chapel for religious exercises, recitation, etc. In the same year, with a daily average of 469 patients, there were 15,802 days' work done by them on the farm, in the kitchen, in the sewing-room, and in the laundry.

At the McLean Asylum, several carriages are kept for the exclusive use of the patients, and the pleasant rides and excursions constitute a large part of the treatment, while the excellent library furnishes abundant material for that kind of occupation.

At Dixmont there is a book-case and library in nearly every gallery, and the daily gymnastic drill in a bright, cheerful hall, with the pretty costumes, adds an interest and zest to an otherwise monotonous afternoon. At this asylum, in 1876, with a daily average of 500 patients, there were 70,933 walks taken; 10,157 attendances at magic-lantern exhibitions, 16,558 at church, 4,327 at parties, 2,972 at other entertainments; 2,984 rides; 3,928 calisthenic exercises [for

* Report for 1875.

ladies] and 8,893 days of labor. In scientific work, full trials have shown "that colored light has no greater power in the cure of insanity than colored water in the treatment and cure of the diseased stomach of an inebriate."

At the Retreat, in Hartford, a delightful amusement-room is open to the patients through the day, and is often pleasantly filled in the evening. Within a couple of years, too, a chapel* has been built, through the munificence of friends of the asylum, a little way from the other buildings, and in every respect like those for "sane" people. The daily evening service and the Sunday exercises, with the walk in the open space, give the patients a feeling of self-respect which they cannot have when constantly reminded of their infirmities by guarded windows everywhere and other indications of their deprivation of freedom.

Present Condition.

At the same time, in the words of one of our most distinguished alienists, the general "propositions (of the American Association of Superintendents) in regard to the construction and organization of hospitals, and the general management of the insane (in the United States), have all, or nearly all, now stood the test of a quarter of a century's trial,"† which is equivalent to saying that there has been little advance in that time.

In construction and internal arrangement, the best American hospitals for the insane are not excelled by those in any part of the world, with the exceptions that they usually have insufficient provision for the employment and occupation of the patients; that they have no hospital-wards and nurses, where such patients as require them may get the benefit of quiet, rest, and the care and attention common in ordinary hospitals; and that the restrictions upon the liberty of the inmates have not, in all cases diminished to correspond with our advance in knowledge and with improvements in other parts of the world. These defects we share with most of the countries on the continent of Europe.

*This is, so far as known, the first in this country (i. e., the first like those in ordinary life) although they are not uncommon elsewhere.

†It is interesting to compare this with the statement, in 1862, of Damerow, the leader of the conservative party in Germany, that there is nothing further to be got in the future to improve the public institutions for the care and cure of the insane!

In costly arrangements for "convenience of administration," in the magnificence of their central or administrative buildings, and in the multiplicity of labor-saving machinery, where it is difficult to find enough for the patients to do, the new American state hospitals for the insane are absolutely without rivals.

Less than half a dozen* of our States are now providing properly for all their insane, the expensive buildings which have lately been thought necessary being absolutely beyond the means of many of them.

The condition of our worst asylums may be inferred from the report for 1872 of one of our medical superintendents, who says:—

"In the appropriate tabular statement accompanying this report, there are several colored people reported as having died from various forms of disease. To have been strictly truthful, that report should have read, 'died from want of proper accommodations'; for I verily believe their lives might have been saved, if I could have had the proper facilities for their comfort and care at my command. Every one knows the inefficacy of medical attention in the treatment of diseases, where the patients are confined to such miserable cattle-stalls as are our colored patients."

In 1871, a newly appointed superintendent in Texas found restraint-chairs, dark rooms, iron handcuffs, locked boxes, and cold shower- and plunge-baths in common use. He thought it necessary to state his opinion "that the infliction of punishment for misconduct on the part of any patient is entirely out of place." The records and journal were not to be found.

In 1876, chains were still used in the department for the insane of the almshouse at Baltimore.

* "Of all spectacles of human misery which the light of day looks upon, we suppose that of the lunatics in American almshouses is the most pitiable. Unlike many sufferers under the great evils of society, they are often persons who have been in better circumstances, and who must, in their dim way, feel and see the abuses of their treatment. In the country poorhouses, they are treated as lunatics were a hundred years ago in Europe. They are chained, put in cages, beaten, kept in dark holes, without fire, often naked, their food reached to them as to beasts, their clothes seldom changed, without bedding, except straw, left in their own filth, and eaten by parasites. This horrible treatment was (till within three years) common in many of our States, and is still the fact in the majority." [The Nation, No. 560, New York, 1876.]

The city insane asylums of New York and Philadelphia were fitly described in 1875, by a distinguished English visitor, as being a disgrace to our civilization.* He also found,† close to our largest and wealthiest city, in one ward, "a rampart of iron bars, strong enough to confine lions and tigers in a menagerie." In some of our asylums, reputed to be among the best, there are still dismal corridors and gloomy wards, which, however, will probably be altered as fast as circumstances admit.

The Twenty Years' Leadership.

It is not difficult to see why our asylums for the insane were better than those of England for about twenty years, as mentioned above.‡ Neither country had, in 1836, begun teaching medical disease clinically in the hospital and at the bedside; nor was it the custom in either to make careful post-mortem examinations as a basis of study, as had been done for nearly half a century in Italy, France and Germany. Neither country had any association or inspecting officers (excepting the metropolitan district of London) to compare and report upon the progress of the different hospitals.

So far we were alike. Our great advantages were two: (1) That the principle of supervision by the state of *individual* asylums had been adopted by us in 1818, while, throughout England, state supervision, although more efficient than ours, did not begin until 1842; and (2) that we had not a large number of old asylums, private and public, with traditions and usages of years to overcome. Everything with us was new, and the pauper and otherwise helpless classes were only beginning to accumulate.

MODERN METHODS OF LESS RESTRAINT.

During the last twenty years or more, dating from the time when the first insane asylum was built with wooden sashes, large window-panes, and no iron guards, the English and Scotch asylums have advanced faster than any others; so that

* These have been improved since that time; but there are many others that are still worse.

† Notes on Asylums for the Insane in America. By John Charles Bucknill, M.D., F. R. S., F. R. C. P. London, 1876, page 53.

‡ See page 347.

those people now stand at the head of the nations of the world in the provision which they make for the care of the insane. In accomplishing these desirable ends, they have three important advantages over us.

1st. There is a careful and critical examination by experts* of every asylum in the kingdoms at least once a year, from which public reports are published of the condition and progress of the various institutions, whereby local authorities are forced to make adequate provision for their insane, and through which each superintendent may compare his work with that of others, and see whether he falls behindhand in the race.

2d. Mental disease is taught clinically† at the bedside and in the sick-wards in every important medical school; careful post-mortem examinations‡ are the rule and not the exception in their asylums, and, as a result, pathological investigations are more common than with us.

3d. The British Medico-Psychological Association, including in its ranks physicians interested in mental disease, whether superintendents of asylums or not, in their yearly meetings, bring out a broader view of the field than if participated in by superintendents alone.

There are still, however, in England and Scotland, enough asylums which may well occupy the attention of their philanthropists; and, although there are many points in which we can learn from their best asylums to our advantage, Dr. W. Lauder Lindsay has testified,§ after a visit to this country, that, "so far from its being the case that we have nothing to learn from the Americans in our treatment of the insane, I will, I think, have no difficulty in showing that in

* These correspond to the *inspecteurs des aliénés dans les établissements spéciaux* and to the *inspecteurs des asiles publiques d'aliénés* of France. There are not yet any laws for the German Empire; but each state supervises its own insane, generally through the *Provinzial-Verwaltungs-Rath*, or under the direction of the *Ober-Präsident* of the *Verwaltungs Commission*.

† In 1837, Dr. Browne's work, already referred to, called attention to the want of clinical instruction in mental disease, and it was then begun almost at once.

‡ The commissioners say, in their twenty-fourth report: "With the all-important view of advancing the knowledge of the pathology and treatment of the various forms of insanity, we think that the practice of making post-mortem examinations should, as far as possible, be everywhere the rule, and not, as in many instances, the exception. It ought also, in our opinion, to be applicable, under the same conditions of consent on the part of the relatives, to all classes of patients." The proportion of such examinations to the deaths rose from 40 per cent. in 1869 to 61 per cent. in 1873.

§ Edinburgh Medical Journal, December, 1870.

not a few important respects, they are decidedly (to use one of their own characteristic expressions) 'ahead.'"

There were in England in January, 1874,—

72	pauper	insane	asylums,	averaging .	. . .	456	patients	each.
5	asylums	for	the	better	classes,	containing	over	. 200 " "
4	"	"	"	"	"	from	150 to 200	" "
7	"	"	"	"	"	"	100 to 150	" "
7	"	"	"	"	"	"	75 to 100	" "
9	"	"	"	"	"	"	50 to 75	" "
29	"	"	"	"	"	"	25 to 50	" "
80	"	"	"	"	"	less	than 25	" "

One of the most striking of the changes* brought about, or rather commenced, is the individualizing of treatment and the separating of patients as much as possible from morbid influences, by the increase in the number of small asylums,—a very wide departure having been made from the position taken by Dr. Bell a third of a century ago, that "experience shows that the very highest curative advantages are effected by the mutual action and attrition of diseased minds upon each other,"—a point upon which Griesinger says,† "Nowhere is there greater need of strictly individual treatment than with the insane; nowhere must we more constantly bear in mind the fact that not a disease, but a diseased individual, not insanity, but one who has become insane, is the object of our treatment"; and Roller, when speaking of those suffering from mental disease, states the principle more forcibly still: "*Nur von unkundigen wird es bestritten dass das zusammensein mit andern kranken‡ die Heilung befördert*" (only the ill-informed contend that congregation with others favors recovery).§

A few of the asylums in England, of which Bethlehem was, I think, the first, have imitated the example of the

* These will be illustrated chiefly by letters which explain themselves. Some of the best asylums, with their advantages in employment, personal freedom, etc., of the patients, have been described by Dr. H. B. Wilbur, superintendent of the Idiot School at Syracuse, who visited Europe by request of Gov. Tilden of New York in 1875, in an interesting treatise on *The Management of the Insane in Great Britain*, Albany, 1876.

† Die Pathologie und Therapie der psychischen Krankheiten, Vierte Auflage, Braunschweig, 1876, pp. 472 and 473.

‡ This word *kranken* (the sick) is very commonly used now by German writers in referring to the insane.

§ Op. cit. p. 4.

metropolitan hospitals in establishing summer resorts and convalescent homes for their more quiet patients, so as to get them away from the asylum influences, and with the best results.

In Scotland,* there were in 1874, 8,069 insane under the care of the commissioners. In 1858, there were estimated to be 2,000 beside those known officially; but their present number, which does not appear in the reports, is probably not so great. Of these 8,069, 4,717 were in seventeen royal and district asylums, 338 in eight private asylums, 748 in six parochial asylums, 565 in fifteen workhouses, and 1,650 in private dwellings† and training schools.

About four-fifths of those under the care of the officials, and known to them, about 70 per cent. of the whole number, were therefore in asylums and workhouses.

According to the statistics and estimates of our Board of State Charities, about 60 per cent. of all the insane in Massachusetts are in public institutions, the preference being given to the severer cases; so that the average degree of severity of disease in our asylums, as compared with those of Scotland, may be roughly estimated as 70 to 60 or as 7 to 6, not allowing for any difference arising from nationality or character of disease, if there be such.

Opinions and Letters.

Dr. Bucknill, after his long visit to this country, writes to Dr. Edward Jarvis, October 31, 1875: "You have no idea in the States of the amount of freedom, under due supervision, which our lunatics get; and it is constantly being increased,

* There has been little that is distinctive in the early history of the treatment of insanity in that country. The Scotch laws placed the rich insane in the hands of guardians as early as the thirteenth century; in modern times they have rather followed the precedent of England. The Commission in Lunacy was appointed in 1855.

† It would carry us beyond our limits to fully describe this system of boarding out the insane in families in the villages of Scotland. It is done at a cheap rate, and the patients are reported, many of them, at least, as liking it better than asylum life. But any one who has endeavored to find a boarding-place for a single one of them can appreciate the difficulty, and often impossibility, of finding in this country suitable persons who are willing to undertake such care and responsibility for strangers. There is an objection, too, in placing a dependent class in the charge of such persons as are willing to take them. The best account of this Scotch system, "*Ueber familiale irrenpflege in Schottland*," may be found in the *Archiv f. Psychiatrie und Nervenkrankheiten*, Vol. V., 1875, pp. 164-188. It has been said in England that these insane boarders are not always adequately looked after.

and with the best results. We are now pretty well rid of the old superstitious fear of the insane; and, where the bounds of insanity have been so much enlarged, it was time that this should be so."

Dr. Tuke and Dr. Fraser.

One of the most interesting experiments has been made by Dr. Batty Tuke, and carried out by his successor, Dr. Fraser, whose letter, originally published in the Boston Medical and Surgical Journal, is so full of suggestive matter that a considerable part of it is given here. It should be said that the asylum is quite in the country, and that the patients are mostly of the quiet, agricultural class. Herbert Spencer considers this one of the most important steps of the day in the treatment of mental disease. Undoubtedly it is such; but it would not be fair to infer that all asylums and all the insane in all places can be treated in this way.

Some of the windows open freely, others are so arranged that neither sash can be lowered or raised enough to permit the egress of a patient. The separate wards of the main building are semi-detached and of only two stories each. If Dr. Fraser had described his autopsy- and microscope-rooms, it would have been seen that he considers careful pathological research of the utmost importance.

The cost of this asylum, without furniture, was a little less than seven hundred dollars per patient.

"FIFE AND KINROSS DISTRICT LUNATIC ASYLUM, }
"CUPAR, FIFE, SCOTLAND, January 28, 1875. }

"MY DEAR SIR:—I have the greatest possible pleasure in acceding to your request for a description of my asylum.

"It is the district or pauper asylum for the counties of Fife and Kinross. The population of the two counties is one hundred and seventy thousand. The institution is capable of holding two hundred and eighty inmates. The present numbers are one hundred and ten males and one hundred and thirty-eight females, or about two hundred and fifty altogether. The yearly admissions are from eighty to ninety. There is one attendant for every twelve patients. The patients are classified, and each class has its own gallery; the highest number in any gallery is twenty-four; the lowest, twelve. The female department has seven galleries, each complete in itself; that

is to say, each of them has its own day-room, dormitory or dormitories, single sleeping-rooms, lavatory and conveniences. Four have two attendants, two only one. This divisional arrangement, though I believe it adds to the working expenses, admits, as I have said above, of classification of the patients. The day-rooms or sitting-rooms for twenty-three patients are thirty feet long, twenty-one feet broad, and eleven and a half feet high. The windows of these rooms are nine feet by seven feet, and the panes are twenty-two inches by eighteen. There are no window-panes smaller than twelve inches by ten and a half anywhere. The lower half of the windows has brass rods three-eighths of an inch thick running transversely across the panes and through the woodwork of the window-frame. I could wrench these rods out with my hands. There is no such thing as an iron bar across a window, and all our window-frames are of wood.

“You ask me for the features which distinguish my asylum. I believe these to be: 1st, unlocked doors; 2d, the great amount of general freedom; and 3d, the large number on parole. In common with the Argyllshire asylum, airing-courts are not in use. The great attention given to the occupation of the patients and the large percentage of those employed are characteristics of this asylum as well as of two others in Scotland.

“First, as regards open doors. Here is a paragraph from my last annual report to the directors:—

““I wish now to describe the peculiar feature of your asylum; namely, the open-door system. It was originated about three years ago by your former physician-superintendent, Dr. Tuke, and I have no hesitation in saying that the introduction of this system will mark an era in the history of the treatment of the insane. As you are well aware, there are no high boundary walls surrounding the grounds, and the entrance gates stand always open. To make this system as clear as possible, let me suppose that a visitor calls and wishes to see through the asylum. He is received at the front door, which will be found open; he is then conducted through the whole of the male galleries, containing over ninety patients, and thence, *via* the dining-hall, through five of the galleries in the female side, also containing over ninety patients, without *once* coming upon a locked door. Not only is there this free communication inside the house, but the outer doors of the main ground corridors, which open out on the terraces, are also unlocked. The male convalescent building, which contains from twenty to twenty-five patients, has its doors open from shortly after six A. M. till eight P. M. The inmates are, of course, on parole. Two galleries in the female department still remain under the old system of locked doors. Though not

necessary for the majority of their inmates, yet the erratic and mischievous tendencies, as well as the excitement of some three or more in each division, render locked doors necessary. Greater contentment is, I believe, the result of the innovation I have just referred to; the sense of confinement, or in other words, of imprisonment, of which even a lunatic is conscious, is absent. The asylum is converted into a home and a hospital. A greater number of escapes and accidents would *a priori* be expected from this state of freedom. The escapes have been nine in number, and there are only two which can be attributed to open doors. Four accidents, none of any import, except the suicide previously detailed, have occurred during the year, but none in any way attributable to this system.'

"This bold advancement in the treatment of the insane, is, as I have said above, wholly due to Dr. Batty Tuke. It is to his original mind, to his enterprising spirit, to his confidence in a portion of afflicted humanity hitherto unconfided in, and to his faith in the adage, 'The more you trust, the more you may,' that this new era in the life of the insane has been initiated. I must confess I shook my head when the doctor first proposed it, and our matron said she could not see 'how it would do at all.'

"The history of this movement is interesting. At first a great deal of wandering about the house occurred, especially from the galleries to the kitchen. A number wandered outside, and some of course attempted escape. Gradually the patients were taught when they were to go out, and what parts of the house they were permitted to visit. Those who escaped were spoken to in presence of the others: they were informed of the inutility of escaping, of the certainty of their being brought back; that they must remain in the asylum until they were better; that every kindness would be shown them; that everything they had to say would be heard and attended to; that when the time came they would go out by the front door, and that the doctor would be there to say good-by and wish them well. It was wonderful how the most determined bolters ceased from attempting to escape. I could quote a dozen cases where a remarkable change in this respect occurred. The most intelligent escapers were taken to the doors, shown their openness, and then informed that confidence was reposed in them, that escape was unproductive of any good, and that the way to get home was to show themselves worthy of trust. Not only with permanent residents did this state of imposed confidence have a beneficial effect, but also with transfers from other asylums. For example, a lady patient was admitted some time ago from another asylum. The account sent was that she was most determined in her attempts at escape, that she had broken the framework of her window and

set fire to doors in order to escape. Her habits were said to be dirty. It was a case of moral insanity, and the intelligence was keen and clear. After admission, she was shown the open doors (one leading out to the terrace within ten yards of her sitting-room), and the freedom that existed. Confidence was preached to her, and she was informed that good behavior of every kind was expected of her. She now walks out daily on the terraces, unattended, whenever she likes, yet there has never been the least attempt at escape. She has never been dirty in her habits. This patient has been in three other Scotch asylums, and she says that this is not like an asylum at all, that it is unlike any of the others she has been in, and that here she has no desire to run away.

"Your experience of the insane will cause you no doubt to say, 'But all cannot be treated in this wise.' I grant that, but what I wish to impress upon you is the great number that can. You will see I have two departments on the female side under the old *régime*.

An attempt was made to leave one of these off the lock, but the mischievous doings of three chronic maniacs, and the incurable wanderings of two or three demented and suicidal patients, prevented the open door from being persevered in. Excepting these, the rest, numbering from one to eighteen, would be all the better for the unlocked doors. The other department is one of our new buildings, and is separate. From its situation and its inhabitants, chiefly chronic maniacs, it would be inexpedient to attempt the step there.

"I wish especially to describe our male convalescent building. It is a house capable of holding thirty-three patients, but at present there are only twenty-two resident there. Its doors are open every day from seven in the morning till eight and nine in the evening. The inmates are all on parole. No one has broken his parole during the last two and a half years. An attendant and his wife have charge of the place. They have a little child five years of age. They all sit down to meals together, the patients, the attendant, his wife and child. The latter two mix with the patients at all times. This was also a step of Dr. Tuke's, and admirable have been the results. When men associate only with each other, they are apt to degenerate; coarseness, swearing, and fighting predominate; but when a woman is present, and especially when a sweet little girl mingles with them, then swearing and angry passions cease; at least such has been the effect in this department of my asylum. There are two dormitories upstairs, one in which no attendant sleeps (ten patients are left to themselves), and the other is in charge of an attendant who comes down from the main building for the night. This place is our Gheel.

“ I believe that the conditions above described, coupled with constant occupation, result in (1) greater contentment and general happiness among the patients, (2) better conduct in every one, *i. e.*, less excitement, (3) the preservation of the individuality of each patient, (4) less degradation, and (5) greater vigilance and care on the part of the attendants. As regards the fourth result, I believe it to be strikingly true.

“ Occupation is what I have the utmost confidence in. Its results are most beneficial. Almost every male patient can fill and wheel a barrow, and the majority can use a spade. So almost every female patient can use a needle and thread or a knitting-needle. Constant supervision soon teaches one what is most suitable to each. I beg to refer you to Sir James Coxe's report, which you will find in the annual report which accompanies this letter. Here is another paragraph from my last annual report: ‘ Attention is being constantly and increasingly directed toward the occupation of both sexes. At the present date, all male patients, with the exception of from five to eight, are sent out every day in parties arranged according to their capabilities for work. Attendants accompany each set of workers. The head and sick-room attendants are the only ones retained in the house. On the female side there are three workrooms, one devoted to the main sewing requirements of the house, and the others to the teaching and encouraging to work of the idle and demented. In these three rooms are above ninety patients. The laundry, the kitchen, and the house generally give employment to about forty more, so that the actually idle are reduced to a minimum. My desire and aim are to make your asylum a veritable beehive. The men work both forenoon and afternoon, but their hours are not long. The females, though kept at work in the forenoon, spend the afternoon in walking and out-door recreation. I am at present dispensing with the use of airing-courts, but I shall make no comments on this step until after a year's experience.’

“ Airing-courts are a mistake, especially for females. Not long ago I used to send out the demented, the chronic maniacs, and the idle to the airing-court of a morning. Of course, having nothing useful to do there, they did mischief, quarrelling among themselves, getting excited, and increasing their destructive habits. The patients being safe within four walls, and out of sight, the attendants were heedless, habits and practices occurred which the attendants, for the sake of decency and for the respect of their sex, would have been active and vigilant to prevent elsewhere. Those who used to go to the airing-court in the morning are now collected around tables and set to work at knitting, sewing, darning, etc. The

contrast between the airing-court and this room is very striking. This very morning this workroom was quiet in the extreme. I went round them all, spoke to each, praised their doings, and encouraged the idle, and there was not a word out of place. Had they been in the airing-court they would have been squatting in all the corners, rampaging about, holding forth in loud tones, etc. Occupation and the working together in the way described have a most decided inhibitory effect. The airing-court system permits every insane propensity to run to weeds.

“During the present year there have been two or three cases subject to paroxysms of great excitement. I have occasionally been present in the galleries when such outbursts have occurred, and have been witness of how the peace, quietude, and industry of the other inmates have been disturbed, and the excitable roused. Great destructive propensity is generally a feature of these attacks. In such cases, one of two things must be done: the patient must either be restrained by two or more attendants (the worst form of restraint), or put into seclusion. The former plan cannot be carried out where there is a minimum staff, but even had I sufficient at my command, I believe seclusion to be the more beneficial mode of treatment in every way. There are cases,—at least this asylum possesses such,—in which great coarseness of language characterizes the paroxysms; and I maintain that such cases, in consideration of the feelings of the other inmates and attendants, demand their temporary seclusion. Constant supervision of the galleries has determined me in this opinion. Restraint I have not resorted to.

“As regards the chronic harmless insane, I here subjoin another extract from my report: ‘It is my opinion that many chronic lunatics do not require asylum treatment; they can be sufficiently cared for and guarded by their friends or others whom the proper authorities deem fit custodians. The chronic lunatic I refer to is one who is harmless, trained to be cleanly, and perhaps industrious, whose mental condition may be described as that of a premature second childhood, and of whose recovery no hope can be entertained. Such an one does not require constant medical supervision, the expensive appurtenances of an asylum, nor the services of trained attendants.

“Dr. Arthur Mitchell’s book on the insane in private dwellings will give you a most graphic account of what formerly existed and what exists at the present day.

“I trust the foregoing remarks convey the information you desire, and I shall be only too happy to answer any further inquiries you may wish to make. If any of my professional brethren on

your side of the water desire to see this asylum, they will find me a most willing cicerone.

“ With best regards, I am, dear sir,

“ Yours most truly,

“ JOHN FRASER.

“ Dr. CHARLES F. FOLSOM, Boston.”

Dr. Clouston.

Dr. Clouston, well known in this country as the successor of Dr. Skae at the Royal Edinburgh Asylum, formerly medical superintendent of the Cumberland and Westmoreland asylum, and co-editor with Dr. Maudsley of the Journal of Mental Science, has begun an interesting work at Morningside, a description of which is best given in his own words. In 1874, he wrote as follows :—

“ *Memoranda as to the Treatment of Insanity, etc., in the Royal Edinburgh Asylum, Morningside, Edinburgh, by T. S. Clouston, M. D., Physician Superintendent.*

“ I have been now for fourteen years engaged in this department of the profession, and have paid much attention to the various modes of treating the insane in this and other countries.

“ My practice in regard to patients, especially of the higher class, is to allow them from the first, as much liberty as I possibly can, putting many of them on parole very soon, and trying to make them feel that they are here really as invalids and not as prisoners. Unquestionably, in those cases where I can thus trust patients, they are happier and recover sooner than they otherwise would. Of course, in some cases I cannot do so. Out of 77 patients of the higher class, over 30 are on parole, 22 of them living in cottages or pavilions where the arrangements are perfectly homelike.

“ Throughout the whole department for the higher class I am substituting large plate-glass for small squares in the windows, and am trying to remove all prison-like arrangements. So far as we have gone yet, in the eighteen months since I came here, the effects have been very good indeed on the patients, and we have had no accidents.

“ I send a short description of the cottages, with photographs. The main part of the house consists of three wards for gentlemen and three for ladies, with a few private rooms and parlors. Each ward contains about eight patients, and in some cases two, and in the case of one ward one, attendant. There is a parlor or corridor open and lighted on one side, and with a row of bedrooms on the

other. We are building two new dining-rooms, chiefly of glass, to look like conservatories, one for the gentlemen and one for the ladies, and we have already one very handsome dining-room for gentlemen who pay over £105 a year. There is a large drawing-room where the ladies and gentlemen meet in the morning for prayers, and in the evenings twice a week for cards, readings, dancing, etc. The gentlemen have a billiard-room. All these public rooms are precisely like those of a good house in their arrangements, the doors opening the same way, etc.

“As much as is practicable, I send my patients to walk and drive out beyond the asylum grounds, to town, to the museums, picture galleries, etc.

“Believing that the first object of the institution is to cure as many of the patients sent to it as possible, and to enable those who are incurable to lead as happy lives as possible, I deliberately run risks as to escapes, and even in some cases of mild melancholia as to suicides, with those objects. It is quite easy to arrange an asylum so that no escapes shall take place from it, but any such institution I should pronounce to be radically faulty in its principles.

“In the treatment of every case, it is of the utmost importance to find out whether the tendencies of the patient result from an incurable pathological condition of the brain, or from a curable disorder in its working. I should not put a general paralytic or a bad epileptic on parole nearly so readily as a simple case of excitement or depression, though I have now mild cases of the two former diseases on parole.

“I do not believe that ‘non-restraint’ should be so elevated into a ‘principle’ that no departure from it is allowable. Diminish restraint and seclusion by all means to the utmost, but don’t sacrifice a patient’s life, or the lives of those about him, to any such principle. In practice, I have only used restraint once at night in the case of one patient, for suicidal tendencies of the most aggravated kind, and seclusion twice in a year and a half among my higher-class patients. I use seclusion rather more frequently among the pauper class of patients, from having fewer attendants in proportion to the number of patients.

“We take in all cases that apply when we have room.

“There are much fewer windows broken now than when the panes of glass were small and guarded by iron bars, and I think there is an improvement in regard to degradation and dirty habits in many of the worst class of patients.

“For painting, decoration and papering in the institution, I employ the best and most tasteful tradesmen in Edinburgh.

“Description of the Photographs of the Cottages, etc., Royal Edinburgh Asylum, Morningside, Edinburgh.”

“No. 1* is the ladies’ ‘wing’ or pavilion, connected to the main part of the ‘East House’ by a row of sleeping-rooms and passage. The ‘East House’ is exclusively for private patients who pay the higher rates of board, and there is a corresponding wing for gentlemen. The wings contain eight rooms each, and usually accommodate six patients. The gentlemen’s wing has a billiard-room behind it. The arrangements of the wings are precisely similar to those of private houses, the doors being unlocked, opening by their handles, the outer doors (glass) open, and all the windows consisting of large sheets of plate-glass. The patients in the wings form groups separate from the rest of the house.

“No. 2, ‘The Cottage,’ for ladies, containing eight rooms, and usually accommodating four or five patients. It has a dining-room, drawing-room and bedrooms. All the arrangements are those of a private house, unlocked doors, plate-glass windows, etc. The cottage is situated about twenty yards from the asylum.

“No. 3, ‘Myreside Cottage,’ for gentlemen, containing eight rooms, and accommodating five gentlemen, two attendants, a cook and an assistant cook, who is an unpaid pauper patient. It is situated at the extremity of the Royal Edinburgh Asylum Farm, about a quarter of a mile from the asylum. Its arrangements have nothing supposed to be asylum-like about them.

“Altogether in these four buildings there are twenty-two patients out of the entire number of seventy-seven high-class patients in the asylum.”

Two years later, Dr. Clouston writes as follows:—

“ROYAL EDINBURGH ASYLUM FOR THE INSANE, }
“EDINBURGH, 28th Nov., 1876. }

“Dr. FOLSOM.

“MY DEAR DOCTOR:—I duly received yours of the 13th, and I assure you I am only too glad to answer any questions you put.

“As regards any plate-glass experiments now universal in our East House for higher-class patients (containing ninety-two patients), I have the greatest reason to be satisfied with them. Only one pane of glass has been broken in the two and one-half years they have been in, and that by an attendant in cleaning it. To show that I believe in them, I may mention that in some cottage additions which we have lately built and occupied for twenty-four patients, there is nothing but plate-glass, each pane filling up a sash, and that the

* Not shown in this place.



Illustration.

MYRESIDE COTTAGE

James R. Osgood & Co.



1880

THE COTTAGE, MORNINGSIDE

James R. Ogden & Co



Wilmington

THE COTTAGE, MORNINGSIDA.

James H. Osgood & Co

outer doors have all plate-glass panels, and that each parlor has such a door opening into the garden.

“ I have followed some of my Scotch brethren, too, and have done away with airing-courts, so that now we have absolutely no such walled court of any kind at our East House or at the male division of the West House (these two containing four hundred patients). I am sure the general result has been very beneficial, though, in a few individual cases, we miss the courts.

“ As regards plate-glass windows in the West House, we have fairly begun the experiment, having fitted up three galleries, containing one hundred and forty patients, with them, one gallery being on the ground floor, the next on the second, and the next on the third floor. They are immensely more cheerful, and no bad results have followed during the three months they have been in.

“ I think in our asylums here we have too few attendants for our patients to individualize them properly, so I am gradually increasing our staff. We ought to have one attendant to eight for pauper patients and one to three* for private patients, in my opinion, to do them full justice. I am carrying out this without reference to the plate-glass windows or open doors in some wards, etc., but in accordance with what I think is required for proper treatment.

“ The question that is bothering us most here now is that of disposing of our chronic, harmless cases.

“ I am very truly yours,

“ T. S. CLOUSTON.”

In Dr. Clouston's East House, the same class of patients and the same character of disease are treated as in our corporate asylums. The West House is for non-paying patients.

It cannot be said that Dr. Clouston has a mild form of disease to treat; for, by his last report, it may be seen that, of 310 patients admitted in 1875, 60 had attempted and 31 others had meditated attempting suicide. Dr. Butler, formerly superintendent at the Retreat in Hartford, thought, after visiting Europe, that the form and degree of severity of insanity in the Scotch and in New Englanders are about the same, although milder in the English.

Sir James Coxe.

The following letter from Sir James Coxe of the Lunacy Commission of Scotland, gives a fair idea of the general treatment of the insane at the present time in Scotland:—

* This is about the proportion at the McLean Asylum.

“GENERAL BOARD OF LUNACY,
“EDINBURGH, January 20, 1875. }

“DEAR SIR:—I have the honor to acknowledge receipt of your communication of the 4th inst., requesting information on certain points in connection with the management of the insane in Scotland.

“I have much pleasure in replying to your questions, which I shall do in the order you put them.

“It is the desire of the board of lunacy, that individual asylums shall not accommodate more than 300 patients. It is however impossible to keep them within this limit, as they are built for districts and must be enlarged when demands are made for increased accommodation. At present three of the district asylums are built for less than 100 patients; others accommodate from 200 to 300, and others again exceed 300. The older asylums, which were erected from legacies and charitable contributions, and which also serve the purpose of district asylums without being under the management of district boards, accommodate from 500 to 800 patients.

“In none of the newer asylums are the windows fitted with bars; on the contrary, the window-sashes are of the ordinary construction, the frames being of wood and the panes frequently so large as to permit readily of the passage of the body of a patient. The only precaution taken is to restrict the opening capacity of the sash to a space of about 5 or 6 inches, and, when the panes are of unusual size, to pass a brass rod through the astragals on the inner face of the glass.

“The commissioners look upon asylums merely as convenient arrangements for the disposal of patients. They attach no therapeutic value to the agglomeration of the insane; and, apart from the question of economy, would prefer to see them accommodated in groups of such a size as would ensure every patient being individualized.

“It is the object of the commissioners to facilitate the removal of harmless and incurable patients from asylums and to dispose of them in private dwellings. Curative treatment in private dwellings they regard as surrounded by too many difficulties to receive official countenance. As a rule, the chronic patients removed from asylums are not concentrated in special villages, but are sent home to their parishes to live with friends. Occasionally, however, urban parishes, such as those of Edinburgh and Glasgow, resort to the practice of placing their incurable patients in certain villages and communities of 10 to 50. This practice, however, arises simply



Helmlyke

MONTROSE ASYLUM.

James R. Osgood & Co.

from the difficulty of procuring suitable accommodation in towns. It has been found to give satisfactory results. Not more than four patients are allowed to be received into any one house, but the actual number rarely exceeds one or two.

“There is a growing difficulty in procuring and retaining the services of trustworthy persons of either sex as attendants, a difficulty which is owing to the increased facilities which the prosperous condition of the country affords in obtaining employment in almost every capacity.

“Our experience is, that in proportion as the restrictions on liberty are relaxed, the more easy does the management of asylums become. A movement to abolish walled airing-courts has already acquired considerable development, and, in addition to this, the experiment is being tried of doing away altogether with locked doors, except in one limited portion of the establishment.

“As a rule, mechanical restraint is entirely abolished in Scotch asylums, except in the department of criminal lunatics in the central prison at Perth, where one or two patients are generally found with one or both hands restrained as a protection against impulsive violence. Occasionally, in ordinary asylums, a patient may be found wearing a strait-waistcoat to guard against sudden outbursts of violence, or to prevent his injuring himself, but, as a rule, mechanical restraint will not be met with in more than one or two instances in making the whole round of our asylums.

“Trusting you will find that my answers to the questions you have asked will give you the desired information,

“I am, my dear sir,

“Yours very truly,

“JAMES COXE.

“DR. CHAS. F. FOLSOM, *Sec'y of the State Board of Health, Boston, Mass.*”

The accompanying photograph of a portion of the Montröse Asylum, gives a fair idea of some of the later accommodations for the more quiet of the insane who pay either nothing or low rates of board.

Dr. Rogers.

The next two letters, from a physician of large experience and eminence in the treatment of mental disease, sufficiently explain themselves.

“COUNTY ASYLUM,

“RAINHILL NEAR PRESCOT, January 18, 1875. }

“MY DEAR SIR:—This asylum, as originally built, was in blocks, three on each side, connected with covered passages, two wards in

each block, one above the other, and the largest ward only having capacity for 34 patients. With the great demand for increased accommodation, two new blocks were built, three stories high, having bedrooms on first and second floors and none on the ground floor. These blocks contain 124 patients each.

“It is obvious that the same amount of supervision and of individual attention cannot be bestowed on each patient in these large wards as in the smaller ones, and therefore they are only advantageous where a large proportion of the patients are chronic cases and fairly tranquil and orderly.

“A similar arrangement of large sleeping-rooms has been made over the laundry, but this is objectionable, in my opinion, and I would prefer that the laundry should be untenanted, except during the daytime.

“There never were bars to our windows, which are all of the same size, both for the quieter wards and those for the worst class of patients. Locked fire-guards were originally in use, but these have been removed for twenty years. A former superintendent even had all the Venetian blinds removed from the windows, but I have replaced many of these for convenience and comfort's sake.

“With regard to the number of windows broken, this depends a great deal on the propensities of individual patients. With some, the propensity is only transitory; with others, permanent. I have now an inveterate window breaker—a woman. The moment anything occurs in the ward to call off the attendant's attention, she takes the opportunity to break as many windows as she can; in one month she broke 80. Her object is to get put in seclusion, where she is happy. I should not think of using restraint in this case, as a principle, if it be worth anything, is worth more than a few panes of glass; besides, the tendency to window-breaking is generally due to some condition of health which may be improved by treatment—most frequently a weak state of health with excitement. This is not so in the case quoted, who, although a phthisical patient, is at present in very good health.

“I am decidedly of opinion that the use of restraint tends to confirm and strengthen degraded and animal instincts, and that treating the insane as rational beings has the tendency to develop self-restraint and decency.

“That this result is often very long in being produced, and that in some patients never is produced, is no argument against the general rule, and I hold most decidedly the opinion that there are no patients so degraded in habits but that they are susceptible of humanizing influences, provided there is no progressively active brain disease present.

"I might add a few words on the subject of attendants. This is a fruitful source of complaint amongst English physicians and superintendents, and of late I have found the difficulty of securing and retaining the services of good attendants greater than ever before.

"I attribute this partly to the hostile feeling which exists, and which constantly tends to break out amongst the superficially educated, on the subject of asylum management, which was illustrated by sensational articles in many of the public papers (medical included) a few years ago. These had, as it appears to me, the effect of making present attendants shirk their responsibility and seek their own interests rather than that of their patients, and of preventing eligible men and women from undertaking an employment which was so calumniated. The great increase of wages throughout this country has, of course, also tended to make employment more easily obtained, as well as the shortening of the hours of labor to contrast unfavorably with the hours of an attendant's duty. But of one thing I am convinced, that a mere advance of wages will, even if it induce a better class to undertake the duty, not ensure its being better performed. What is wanted is a training institution similar to what we have in London and Liverpool for hospital nurses, provided by Miss Nightingale.

"Yours sincerely,

"T. L. ROGERS.

"Dr. CHAS. F. FOLSOM."

"COUNTY ASYLUM,
"RAINHILL NEAR PRESCOT, December 1, 1876. }

"DEAR DR. FOLSOM:—Our English county asylums are visited once a year by the commissioners in lunacy,—i. e., by two members of that Board, a medical man and a legal member,—and every two months by two or more members of the committee of visiting justices. These are all the statutory visitations, and the rules for visiting made by local committees vary greatly, from weekly visitations, as in Middlesex, to quarterly, as in Yorkshire.

"Here, we used to have a rule that a magistrate should visit between each monthly meeting of the committee, but that has not been observed now for years, and only the statutory visitations are made. . . .

"I object strongly to any set of men arrogating to themselves the right to determine how another set should treat any kind of disease, and, although I certainly am of opinion that our system of treatment of insanity is better than yours, I have no right or wish to assume that yours is incapable of being defended.

“By the way, Dr. — of — visited this asylum a fortnight ago with an introduction from your consul in Liverpool. I was unfortunately away from home, but my deputy informed me that he had particularly wished to see the implements of restraint, and seemed incredulous when informed there were none in the establishment; and this seems, from what I read and hear, to be the prevailing feeling in America; viz., that we do not really act up to our professions. If this were so, it would be far worse (at least in my eyes) than an open use of restraint. If, however, your countrymen would take the trouble to make inquiries, either through their consuls, or, still better, by personal examination of our asylums (and I am certain they would always be gladly welcomed), they could satisfy themselves how far the system of non-restraint was actually in force in England at the present time. However, as I went rather fully into the subject in my presidential address in 1874, a copy of which I believe I sent you, I will not give you a second edition of it here.

“I am yours sincerely,

“T. L. ROGERS.”

The following notes by the writer in regard to Tue Brook Villa, near Liverpool, and the West Riding Asylum at Wakefield, England, illustrate some points which may be suggestive here :—

*Tue Brook Villa.**

“Reaching Liverpool, and not having much time to spare here, I at once called on Dr. Owen at his private asylum for the treatment of mental diseases. When I went to see him two years ago, I thought that by mistake I had strayed into some gentleman's private grounds. The gate was swung wide open, there was not a fence in sight over which I could not have easily vaulted, the hospital in the distance had an attractive, home-like look, and the well-trimmed hedges and newly mown lawn looked only the more picturesque with the herd of Ayrshires and occasional groups of men and women here and there. As I got nearer, I found in the faces of the people unmistakable evidences of mental disease. Some were strolling about, or sitting under trees, entirely alone, on parole, that is, having the liberty of the grounds, provided that they kept within certain limits. In other cases, one attendant looked after a group of cases or a single patient, according to the severity of the illness. Inside the hospital the pleasant sitting-

* Boston Medical and Surgical Journal, August 26, 1875.

rooms with their cheerful open fires (which are really not an atom more dangerous than gas-burners, sharply-pointed scissors, knives and forks, and steep stairways) had a quieting influence which is not got from opium or chloral. Those of the fifty patients who could control themselves sufficiently dined with the doctor's family, a privilege which they appreciated highly, and to gain which they exercised a great deal of self-control. This daily stimulus to their self-respect had a really wonderful effect; and as I sat at the table conversing with one after another, the windows wide enough open to throw out a wheelbarrow, and the doors all unlocked, I had time to prepare myself for Dr. Owen's statement, based upon an experience of over twenty years, that in building a new asylum he would have only such doors and windows and fences as are found in a gentleman's private house and grounds.

"Dr. Owen has one assistant physician and twenty-five attendants, whom he can employ in case of necessity, although so many are not always needed; that is, he treats individuals, and not wards or galleries."

*West Riding Asylum.**

"Having a few hours to spare, a few day ago, while waiting for my train, I made an unannounced visit to the West Riding Lunatic Asylum, from which we have seen so many excellent papers in the medical journals, and whose yearly reports are so interesting and valuable to us. I was fortunate enough to find Dr. Browne at home, and was received with that cordial hospitality which I find so freely extended here to strangers. I have not seen an asylum, and I doubt whether there is one, where the modern treatment of mental disease is so well carried out in all respects as there. The directors pay a large salary so as to secure talent of the first order, and then leave the management of the asylum in all its details to their medical officers. The newer parts of the building were constructed with wooden sashes, and no iron guards of any kind were used. In some of the wards the panes of glass were so large that a patient might easily get out by breaking the glass, if no one were at hand to prevent it. Dr. Browne said that if he were now to construct the whole asylum anew, he should have all the windows made in this way. Even the 'refractory' wards have open fire-places, porcelain vases on the mantel-pieces, prettily decorated walls and nice furniture.

"Of the fourteen hundred patients, not one was undergoing mechanical restraint in any form, and not one was in seclusion.

"Dr. Browne does not even use clothes of indestructible material

* Boston Medical and Surgical Journal, September 9, 1875.

for his violent and "tearing" patients, preferring to have an attendant close at hand until the destructive tendency has given way under medical treatment and occupation. There were no airing-courts in the old sense of the word; that is, bare yards with high walls; but every patient who went out to walk did so in pleasant, tastefully decorated yards. I could not but admire the skill and ingenuity with which the older parts of the asylum had been made cheerful, light and airy. At the end of one rather dark ward, a pleasant light from several gas-burners shone through a beautiful stained-glass window during the day. One great secret of the quiet and order which prevailed was, I think, the fact that all the patients are kept employed as far as possible. Even the carpets, shoes, bedding, cloth, clothes, etc., used in the place were made by the patients. I found some old, demented men darning stockings. Some of them were even blacksmiths. About one-fourth are taught to work at their several occupations after entering the asylum.

"Of course, Dr. Browne has a large staff of competent attendants, one to every eight patients; these attendants are carefully selected in the first place, and all unfitted for the work are unsparingly weeded out. The suicidal patients are watched day and night, and cannot even go to the bath-room without an attendant. We all know what good pathological work is done at this asylum; I need not describe that department. As an illustration of the care which is used to keep the patients from disagreeable sights, I noticed that the two dead-rooms (one for the males and one for females) had been so placed that the hearse coming or going, could not possibly be seen. Many little things like that all over the asylum showed how fully the old theory had been abandoned, that the insane are indifferent to their surroundings. In fact, a great deal was expected in the way of treatment from making them as comfortable and happy as possible. A few minutes' walk from the wards a pretty Gothic church stands out among the trees, to which the patients go with a feeling of self-respect; and there is nothing in it or about it which makes it look different from a church for sane people.

"I have not space to describe the department for experiment, and medical and pathological research. I am sorry to pass over the strictly medical treatment with simply a mention of their Turkish baths and vapor baths (a very important feature) and to say that only a very few patients, comparatively, were taking medicine (not more than five per cent. taking morphia in any form).

"I was very much struck with the good behavior of the patients and with the absence of noise and violence. I suspect that the whole treatment which has been so successful may be described in Dr. Browne's remark to me: 'Treat them as men and women, and

they will behave as such.' I placed the aphorism alongside of my Scotch friend's reply to my inquiry what his treatment was that made his patients so quiet, for I saw many open doors, large wooden window-sashes, no mechanical restraint, and very few prescriptions in the medicine-book. That reply was, 'I believe in a good cook and a big garden.'

"It seems to be generally believed in our country that insanity is of a milder type in England, and that the insane are more easily managed. Of course I cannot say that such is not the case. I can only say that it does not seem to me to be true, and that I am supported in my opinion by careful and competent observers. But the English and Scotch have a great advantage over us in a climate which makes it possible to send their patients out-of-doors to walk or to work nearly every day throughout the year."

Prof. Westphal.

Prof. Westphal, the distinguished successor of Griesinger as superintendent of the department for the insane of Charity Hospital in Berlin, and professor of diseases of the mind and nervous system in the university, writes of Germany thus:—

“BERLIN, October 18, 1876.

“DEAR SIR:—I am very glad to answer your questions as far as I am able.

“The English no-restraint system is, to my knowledge, carried out in Germany at Hamburg, Halle, Göttingen, Charité [Berlin], Hall (Tyrol), Heppenheim, Neustadt, Eburwalde. Of private asylums, I would mention Dr. Mendel's and Dr. Levinstein's in Berlin. It is possible that there are still other German asylums with no restraint, of which I am not aware that they have carried out that system; but there are certainly not many, and it can still be said now that the greatest number use mechanical restraint, even those that are readily acknowledged to be model asylums, as for instance at Illenau in Baden. On the other hand, the no-restraint system is extensively carried out in German Switzerland.

“Window-guards have never yet, to my knowledge, been removed from any German asylum, but I know of one in Denmark, at Roeskilde (on the island of Zealand) in which there are no guarded windows.

“A new insane asylum has not yet been built in Berlin, and the city has lately given up the land which had been bought for that purpose. My advice has not yet been asked; but I should recommend the purchase of a large piece of land to be cultivated by the

insane; a small central building should be constructed, and the greatest part of the patients should be lodged in separate, simply constructed buildings. Such a plan is now being carried out in the province of Saxony, the land having been already bought.

"The no-restraint system was first practised in Germany by Prof. Ludwig Meyer, in the department for the insane of the Hamburg Hospital in 1862—the new asylum (Friedrichsberg) was not then built. Griesinger introduced it in the Charity Hospital (in Berlin) in 1866; but the system has been fully carried out only since February, 1867. There have been since that time no camisoles, etc., in the department of the insane of the Charity Hospital. (Compare the *Archiv für Psychiatrie und Nervenkrankheiten*, Vol. I, 243.)

"I am myself thoroughly convinced that the no-restraint system is the correct one (*das richtige*), and have never had occasion to depart from it.

"I think, too, that the guards may be removed from the windows provided certain patients (*kranken*) have their rooms on the lower floor; for the greatest number of the patients, in my opinion, there are no window-guards needed.

"Hoping these few notes may serve your purpose,

"I am very respectfully yours,

"CH. WESTPHAL."

Under date of January 6, 1877, Prof. Westphal informs me that a part of the asylum at Hamburg is without window-guards, and that the new asylum at Marburg is to be wholly so.

Munich.

At Munich some interesting work is done, as noted in the following description: *—

"The director has recently had one million gulden voted him, without a dissenting voice, for enlarging and improving and beautifying his buildings and grounds. In all his windows (which are guarded now) he is putting panes of plate-glass about a centimeter thick; it cannot be broken by any ordinary blow. In fact, I could not break it with my fist. Each pane costs a gulden, an extravagance which the *Geheimrath* from Hildesheim said that he had not seen even in England.

"Another excellent idea which I noted was the building of large rooms for exercise during stormy weather. The southern sides

* Boston Medical and Surgical Journal, October 14, 1875.

were almost wholly of glass, and the rooms were not to be heated. The sashes are to be taken out during summer, and the space occupied with plants, shrubs, etc. The superintendent is carrying rather far the principle of decorating the grounds and frescoing the wards and other rooms which are for the most demented patients; but he thinks his experience justifies him in saying that by such means he reduces his number of filthy patients 75 per cent."

Dr. Stearns.

Dr. Stearns, the accomplished superintendent of the corporate asylum at Hartford, gives this interesting account of his experience of British asylums. It is an important fact that his use of the non-restraint system for the past year has fully satisfied him of its merits:—

"RETREAT FOR THE INSANE,
"HARTFORD, CONN., May 23, 1876."

"MY DEAR DOCTOR:—You may perhaps be interested to know that I visited Dr. Fraser's institution two years ago and spent a day with him. Of course I need not say that I was greatly interested. No one could fail to be so, with one having the enthusiasm he appeared to have in his work, especially as it extended quite as much to his pathological investigations as to the conduct of the other branches of his labor. The system of unlocked doors he explained to me, and judging by his letter to you the subject has increased in interest with him. I, however, felt then and do now that it is entirely impracticable with us, for reasons which I have not time to mention and which doubtless have occurred to your own mind.

"While abroad, I was specially impressed with the following points connected with the management of their asylums: 1. Occupation. 2. Non-restraint (so called). 3. Personal freedom. 4. Pathological investigations. I refer particularly to the Scotch asylums. It appeared to be the aim of the commissioners to stimulate activity in these directions, specially in those institutions where the superintendent had the requisite qualifications therefor. And here I think the beneficial influence of the system of commissions was specially apparent,—by counsel, advice, etc., helping the superintendents a little out of the beaten track and into new fields. I may say, in reference to the system itself, I think no one who saw the wonderful effects arising from the appointment of medical inspectors in the army during the late war could doubt the beneficial effect of a commission of lunacy. The trouble, however, in this

country is to obtain one properly constituted. If the New England States would combine and appoint men of acknowledged eminence in the specialty, who should devote their whole time to the work, and clothe them with the requisite power, it seems to me such a commission would commend itself both to the public and to the institutions, and great good might come from it. . . .

“Very truly yours,

H. P. STEARNS.”

Dr. McFarland.

Dr. Andrew McFarland of Illinois, a gentleman of many years' experience as superintendent of insane asylums in two of our States, sums up his experience in 1876 in these words :

“We adapt our hospitals to the easy visitation of physicians and convenient administration of medicines, sacrificing, by so doing, the easy and most desirable freedom of action in the patient, which ought to be hampered as little as possible.

“Another of our inherited ideas, equally vicious, is, that the insane man is necessarily a ‘jail-breaker,’ and thus strength of construction is to be the universal feature of buildings for his use. My later experience with the insane has much disabused my own mind on this subject. The number who cheerfully and contentedly accept an asylum on the true principle as a fixed home, from which they are not tempted to stray, very much surprises me. The sight of means of restraint is, I am satisfied, a frequent temptation to break over them. I believe that more of the insane than we give credit for have a consciousness that they need a special home, that the outer world is no place for them, and, if such homes were provided on the true principle of governing diseased minds, they would become more completely attached to them than we are apt to suppose in an experience of structures built to hold them in by physical force.”

Less-Restraint Methods Considered.

These opinions of men of large experience in the treatment of mental disease, and of eminence in their profession, are not quoted as indicating any arbitrary rules which should always be carried out under all circumstances, but to show in what a different light many of the first authorities now look upon mental disease as compared with the views held even twenty years ago. It is, moreover, evident, that for the last century the treatment of the insane has become annually less and less that of restraint.

The climate of England is such that the patients may get out of doors nearly every day in the year, and that is considered by English specialists one of the most important features in their treatment; but in Germany the heat of summer is as intense and the winters are nearly as severe as with us.

It is not possible to prove by statistics that a larger number of cures can be got by this treatment. It certainly is reasonable that such should be the case; and it is thought by Dr. Clouston and others that more and speedier recoveries are the result. It is certain that there is no decrease of recoveries and no real additional danger to the patients or to the community, whereas the comfort and happiness given to a large and unfortunate class more than compensate for the added feeling of responsibility and possibly anxiety on the part of the doctors, and for the increased watchfulness on the part of attendants.

There are in most insane asylums patients so violent that all risks with regard to them should be assumed very cautiously; others so absorbed in their own delusions as to scarcely notice their surroundings; others too demented to perceive them; others still, too ill to do so, and a certain number who, well or ill, are indifferent or superior to their associations. Granting all this, and, for the sake of the argument, that our insanity is more intense than that observed elsewhere, we still have a large class who are not "furiously mad," who are thought to be best treated away from home and in an asylum, and who need everything in the scale turned in their favor in their struggle with a powerful disease. Often with a diseased will and weakened powers of self-control, they need every strengthening help possible. For them, the influences of multiplied restrictions and the inability to exercise what feeling of responsibility they have left, act simply as so many depressing forces. In their case, it is often really the safest to run some risk; and, in trying to be too safe, we should not infrequently, like an over-cautious surgeon, lose our only chance of ultimate success.

In reference to this well-known fact, the late Dr. Bell said, in his report for 1853 (page 26) :—

"It is said that the admission among the early inmates of this institution of one of extraordinary propensities and capacities of

breaking out of any place of confinement involved a useless outlay of thousands of dollars. It was naturally reasoned that, if among the first hundred admissions was included a man so dangerous and violent as to render his certain detention an indispensable duty, and who was yet capable of making his way through all ordinary obstacles, others of the same character would now and then occur. *An entire building was erected predicated on such a possibility, but no parallel case has since [in 35 years] been received.*"

Management and Curability.

It is the almost universal testimony that mental disease has been more easily managed in England by the less restricting treatment of it, and that the asylums have become quieter and more orderly. An illustration of this general principle has been so recently shown in one of our own asylums that a short account of it is given here.

In 1874, one of the county asylums in Illinois was found to have six out of its three hundred patients handcuffed and chained to chairs or walls. Their actions seemed like the stories of sights in Bedlam and St. Luke a half-century ago, and which the writer had thought were not to be seen in these days. On representing the matter to the physicians and surgeons of Chicago, they made an examination and a report, as a result of which the whole evil was corrected and the asylum has been much improved in every way. One of the leading physicians writes, November, 1876, as follows: "I visited the insane asylum on Friday and examined every ward carefully. I wish you could have been there with me, as it did not seem at all like the institution we visited together two years ago. I remarked to the physician in charge that I did not see any patients handcuffed or fastened to the chairs or wall." Of the result of removing the chains and handcuffs, he writes: "The change was noted inside of twelve hours, and the patients who had been chained to their chairs made no more noise than the others; the superintendent said that he had not used them (handcuffs, etc.) since the time when you were there. You said they would behave well enough if they were treated well."

Another striking case is the experience of Dr. J. S. Conrad, superintendent of the Maryland Hospital for the In-

sane.* In May, 1876, he put in practice the system of occupation for his patients; and, from then until October 31, there were 2,724 days of work with less than 200 persons, not including many times when they worked for only a few hours. With a view of extending his experiment, Dr. Conrad purposes buying shoemakers and tailors' tools, and those of other mechanical work. He says: "The amount of work done is really astonishing, and many patients have engaged in outdoor occupation *who were never before outside the walls of the hospital since they came within them.*" As a result, he speaks of his ability to very much reduce the amount of mechanical restraint used, "owing, doubtless, to the greater liberty that we have granted the patients, and also to the restraining influences of the system of occupation which we have adopted. There can be no doubt of the fact that with the insane, as with the sane, the more confidence you use the better." He recommends smaller and separate buildings for purposes of classification.

If our asylums were relieved of their overcrowded condition, and if Dr. Conrad's example, carried out indeed for many years at our state asylum in Northampton by Dr. Earle, were generally followed, might we not hear less of an "American type of insanity" distinguished by greater severity, more violent excitement, more desperate melancholy, etc.?

In the report of the Connecticut Hospital for the Insane, for 1876, Dr. Shew says:—

"In former reports I have alluded to various means employed to divert, amuse and occupy such of our patients as were not in a condition to engage in outdoor labor. Besides our regular entertainments of music, dancing, concerts, lectures, stereopticon exhibitions, readings, etc., which occupy four evenings each week, our male patients have found pleasure and profit in a systematic course of outdoor military drilling, which was conceived as a valuable training exercise for insane men, and has been carried into useful practice by our worthy supervisor, Col. Thayer. So far as I am aware, this is a new feature in hospital management. Early in the season walking parties were formed of from ten to fifty persons, who would leave the grounds and spend an hour or two, and sometimes a whole afternoon, in roaming about the hills, gathering flowers or

* Report for 1876.

picking berries. As the season advanced, Col. Thayer gradually and almost imperceptibly formed those from the different wards into distinct companies, officered by their respective attendants. These companies would go out daily and practise at military evolutions. I am free to confess my surprise at the proficiency attained by many of the chronic insane, who had been turbulent, restless and noisy, or listless, desponding, and partially demented. These exercises were practised one or two hours daily by about 150. It should be borne in mind that these companies were formed of men who were not considered available for farm labor, or, in other words, of that large class of epileptic, maniacal, and demented patients found in every hospital who spend their time in the airing-courts or in the wards.

“About forty per cent. of all the men are regularly employed on the farm and grounds. One of the results of this form of military exercise and discipline was a steady increase in the number of those who were able to be employed on the farm, so that on pleasant days not more than half a dozen men, out of a total of 230, would be inside the building. Another pleasant effect of this form of amusement and exercise was observable in the quietness and order which prevailed in the house. The universal quietness at night was equally noticeable. Rarely was a sleeping dose of sedative medicine required; and from records accurately kept, I am able to report the absence, for weeks at a time, of all forms of mechanical restraint.”

Position of English and European Experts.

It is not universally agreed, even in England, that mechanical restraint should be abolished entirely. Dr. Edgar Sheppard, Medical Superintendent of the Male Department at Colney Hatch and Professor of Psychological Medicine in King's College, London, says of his own practice:—

“Mechanical restraint is resorted to whenever it is thought necessary for the protection of the patient; but it is only necessary in rare and exceptional cases.* I believe its use to be neglected in many asylums to the detriment of the patients. All the windows in Colney Hatch are barred;† but there is no occasion for so prison-like an arrangement. English asylums have improved greatly since less restraint has been used, because of general attention being directed to their once neglected condition; because of legislative enactments, better supervision, etc. Restraint was formerly resorted to in all cases to save trouble, and so it became wholesale neglect;

* This was Conolly's position.

† Like our asylum windows.

now it is resorted to in a few cases, and then only as the best means of treatment." *

Dr. Sheppard's high position, and his experience and ability, entitle his opinions to great weight. By the reports of the Lunacy Commission for 1871, 1872, 1873 and 1875, it is found that less than one per cent. of his patients (averaging 829 each year) wore mechanical restraint for those years,—much less of course than one per cent. at any given time,—and more than half of these were for surgical reasons; although a very different interpretation of the meaning of those who agree with Dr. Sheppard is usually made in this country.

Dr. Yellowlees, a well-known writer on psychology, formerly physician-superintendent of the Glamorgan County Asylum, and now of the Royal Glasgow Asylum, says :†—

"I never hesitate to use restraint when other means fail, if I think it for the patient's good. The cases requiring it are very rare; but it is as certainly right to use it when required as it is wrong to use it when unnecessary. To condemn restraint under all circumstances merely because it has been or might yet be abused, is as unreasonable as to forbid all use of stimulants because they have been or may yet be used too freely. Unnecessary restraint cannot be too freely condemned; but to reject its use when necessary for the patient's welfare is to sacrifice the patient to a sentiment, and to degrade 'non-restraint' from the expression of a great principle into the tyranny of a mere name."

A striking instance of the extent to which the non-restraint treatment has been raised to a principle in England, may be seen in the Criminal Lunatic Asylum at Broadmoor, of which we learn that in 1875, the daily average number resident was 503, of whom 204 had been sent there for murder and 110 for "attempt to murder, maim," etc., and yet "no form of mechanical restraint was used in any part of the asylum during the year." With all this, "there were no instances of the commission of premeditated acts of violence, and no attempt to escape was even partially successful." There was only one suicide during the year, and no accident which could have been prevented by the use of mechanical restraint.‡

* Dr. Sheppard's views are given at length in his *Lectures on Madness*, London, 1873.

† *Asylum Notes*, Edinburgh, 1873, page 13.

‡ *Annual Report for 1875*, by W. Orange, M. D., Superintendent. London, 1876.

As to the extent of the use of mechanical restraint in England, Mr. James Wilkes of the Lunacy Commission writes, under date of January 25, 1875, that it "is now very rarely employed in public or private asylums, and in many it is never used."

As to the amount of such restraint, where it is used, the commissioners, in 1873, when commenting on the fact that in 800 patients treated in one year at a certain asylum, ten different individuals had worn restraint at different times during the year, say that such an amount of mechanical restraint was without parallel at that time in England.

As to the character of the restraining means used, Dr. Yellowlees says : *—

"I have only two appliances for this purpose, which it seems absurd to call instruments of restraint,—canvas gloves which envelop the whole hand, and a jacket such as that worn by all the patients, but of stronger material, and with the ends of the sleeves sewed to the pockets."

The benefits of the change in practice in England are well expressed in Dr. Sheppard's letter.† The position of the superintendents themselves is well represented by the following extracts from letters from two of their leading men :—

(1.) "Restraint in England has a strictly technical meaning, and means a restriction of personal liberty by some mechanical appliance attached to the person ; as a camisole, locked gloves, etc. In this sense I have no experience of restraint whatever. I believe I have seen cases that might, perhaps, have been benefited by it. I have never, however, had recourse to it, perhaps from a weak-minded fear of the name ; but I believe because I objected to its moral effect on the other patients, on attendants, and even on myself." ‡

(2.) "Some superintendents in this country have adopted the extreme view, that restraint should *never* be used ; for, even if a benefit to one special case, its introduction might lead to great injury in other cases. I think this view false in principle and wrong in

* Op. cit., page 11.

† See page 386.

‡ Judging from the extensive correspondence printed in the eighth report (1854) of the Lunacy Commission, this is the position of the majority of English superintendents.

practice. It is my province and duty as physician to distinguish between the use and the abuse, and there are *rare and exceptional cases* in which I deem it as much a duty *to use* some modified form of restraint as I deem it a duty *not to use* it in other cases. The good of the individual patient is the paramount consideration."

Another view is given by Dr. Sutherland, and is essentially the same as Prof. Meynert's of Vienna, that "formerly the patient was strapped down to his bed and not allowed to move; the consequence of which was that the horizontal position favored the congestion of the brain and added to the development of the already superabundant nerve-force, thus producing greater and greater irritation, followed by collapse, typhoid symptoms, and too often death." *

In the second edition (1861) of his work on diseases of the mind, still the standard authority, Griesinger says:—

"When my first edition was published [1845], I agreed with German physicians generally in condemning the non-restraint system. I sympathized with the reform, but could not meet the objections made to it. Since that time, experience from one end of England to the other has answered these objections. I have seen the system in practice, and am convinced. . . . Let no one again say that it is impracticable, . . . or more suitable to the English, because more manageable, than on the Continent, . . . or that the use of it is commendable and its abuse to be condemned. No one can say at what point in the use of mechanical restraint abuse begins; it seems to be almost unavoidable."

He quotes Conolly, however, apparently with approval, as saying that there are rare and exceptional cases where mechanical restraint is best for the individual patient.

It is only fair to say that a different conclusion was reached by Guislain of Brussels, whose work Brierre de Boismont compares with that of Pinel and Esquirol, and who was the best-informed man of his time in regard to the various methods of treatment, having visited the asylums of Italy, Switzerland, Holland, Germany, France, and England, and having, like Griesinger, seen the non-restraint system in practice at Hanwell. He gave Conolly full credit for his noble

* Non-restraint System of Treatment of Insanity. By R. Gardiner Hill. London, 1857.

work, but thought with Ray and Bell, that there were some patients, about one or two per cent., who were better off for some form of mechanical restraint. He said, with Baglivi, "*Aliter enim, in morbis curandis, tractandi Itali, . . . aliter Galli, Hispani, Angli, Germani.*" . . . (Italians, Frenchmen, Spaniards, Englishmen and Germans, all require different kinds of treatment.)

However decided one own's opinion may be on this point, and however honest one's convictions, it must be acknowledged that humane, able and well-informed men still differ as to what is best in individual cases.

Substitutes for Restraint.

It has been thought that there must be some substitutes in England for mechanical restraint,* in wet-packing, etc.; but we find that the Lunacy Commission, in speaking of one asylum where this was used, simply as "medical treatment," say, "This packing should be recorded in the medical journal, and under the head of restraint."

Whether more drugs are used or not, as less physical restraint is resorted to, is chiefly a matter of individual practice, some going so far as to class all use of powerful sedative drugs as "medicinal restraints" to be avoided, and others saying that more narcotics are employed.

It is generally agreed that it has been necessary to have more and better attendants.

Accidents Considered.

The result in England has not been to increase the number of accidents; and it has been stated by Dr. Conolly† and others, although I have been unable to find statistics on the subject, that they have decreased. As compared with our own country, it is found that they have fewer fatal casualties, as the following table (including suicides) shows.

Deaths from a suicidal act committed before admission, sudden deaths from natural causes, as heart disease, epilepsy, etc., are not included.

* Superintendents of asylums and physicians, in like manner, formerly often went to Hanwell to ask Conolly what he used in its stead.

† Eighth report of the Commissioners in Lunacy, pp. 171, *et seq.*

The quiet insane in the workhouses of England, 10,307 in 1866, and 15,409 in 1875, are also not counted. There are almost no fatal accidents among them.

Table showing Fatal Accidents for Ten Years in Asylums for the Insane.

YEARS.	UNITED STATES.*			ENGLAND AND WALES.			SCOTLAND.		
	Inmates of asylums.	Fatal casualties during the year.	Rate per 1,000 patients of fatal accidents.	Inmates of public and private asylums.	Fatal casualties during the year.	Rate per 1,000 patients of fatal accidents.	Inmates of royal and district, private and parochial asylums.	Fatal casualties during the year.	Rate per 1,000 patients of fatal accidents.
1866, . .	7,634	12	1.57	31,520	26	0.82	4,536	4	0.88
1867, . .	8,034	20	2.48	32,822	48	1.46	4,603	8	1.72
1868, . .	7,813	24	3.07	34,437	44	1.28	4,694	12	2.56
1869, . .	9,505	11†	1.16	35,669	42	1.18	4,932	6	1.22
1870, . .	11,332	17	1.50	36,969	31	0.84	5,368	12	2.24
1871, . .	11,449	16	1.39	37,325	41	1.10	5,431	16	2.95
1872, . .	13,540	25	1.85	38,559	58	1.50	5,039	14	2.78
1873, . .	14,239	22	1.55	39,563	50	1.26	5,740	14	2.44
1874, . .	14,512	25	1.72	40,910	20	0.49	5,826	8	1.37
1875, . .	14,403	34	2.36	42,285	42	0.99	-	-	-
	-	-	1.84	-	-	1.09	-	-	2.04

* The figures include 29 asylums in 1866; 33 in 1867; 27 in 1868; 32 in 1869; 37 in 1870; 33 in 1871; 37 in 1872; 41 in 1873; 42 in 1874; 40 in 1875. The records were not counted, as there were no statistics, of five asylums each in 1868 and 1869; of 4 in 1866, 1867 and 1870; of 3 in 1871, 1872, 1873, 1874; and of 1 in 1875.

† Not including six lost by the destructive fire at one of the asylums.

In preparing the table in regard to this point, the records for the past ten years have been consulted. For this country, reports (380 in all) of the various asylums (51 in number) have been examined through the kindness of Dr. Edward Jarvis, who offered the use of his library. The superintendents, also, were addressed personally, with a view to obtaining reports for those years which were wanting. For Scotland, the suicides and fatal accidents are reported in the tables published in the reports of the commissioners. As it was not entirely clear whether all fatal accidents were reported by the English commissioners, a letter of inquiry was sent to Mr. James Wilkes, who very kindly sent the following reply :—

OFFICE OF COMMISSIONERS IN LUNACY, }
19 WHITEHALL PLACE. S. W., 26 April, 1876. }

MY DEAR SIR:—I have been away from London on circuit for nearly a month, and have not been able to reply to your inquiries earlier.

All suicides, both in public and private asylums, are recorded in the tables published in our reports showing the admissions, discharges, deaths, etc., which take place in each. They are also subjects of special investigation by the board, and in most cases copies of the evidence given before the coroner are procured. Fatal accidents are not included in this table; but all are equally the subject of special inquiry, and, when necessary, of personal investigation by the commissioners. They are always mentioned by the commissioners in the reports they make upon their visits both to county and private asylums, and are also commented upon in the annual reports they make to the Lord Chancellor. . . .

I am, dear sir, faithfully yours,

JAMES WILKES.

C. F. FOLSOM, Esq., M. D.

The result of the comparison is to show that Dr. Bucknill is right in saying* "that non-restraint does not encourage nor restraint diminish or prevent the occurrence of injuries from violence,"—at least if the non-fatal accidents are in the same proportion as the fatal. This point cannot be ascertained with certainty for American asylums, as records are not published in all cases, as they certainly should be. In England it is shown by statistics that the non-fatal accidents have very much diminished in the last fifteen years, while the non-restraint system has been more fully carried out.

If we examine the character of the fatal accidents, we find that there are almost none in our best asylums (and the same holds true of the best English asylums) except those which were due to the patients themselves. In the case of all our county asylums, a few of the city asylums, and the departments for the insane in poorhouses, all of which are under the care of men not members of the Association of American Superintendents, and in a few of our state institutions, which are the least creditable to us, either there are no

* Op. cit.

reports or we have been unable to consult them, so that the apparent result is more favorable to us than if all classes of asylums were included in the account.

In the British asylums, too, careful autopsies and inquests are required in all doubtful cases, of which the records are kept and published by the Lunacy Commission ; so that we do not find the euphemism of "autochiria" for suicide, as occurred in one of our asylum reports ; and they are also complete. In the above table of statistics, it is known that all our fatal accidents are not included,* although it is not certain how many omissions there are. The results do not, therefore, possess entire completeness ; but it is thought that, especially for the later five years, they are pretty nearly correct for most of the asylums.

Ten years ago there were many injuries in English asylums attributable to rough handling by the attendants, apparently in some cases such as might have been avoided by the use of mechanical restraint or better attendants. The number has been diminishing, however, and is now very small indeed. But there are still reported in England accidents of a kind and with a frequency said to be entirely unknown in the asylums under the charge of members of the American Association of Medical Superintendents of Hospitals for the Insane. If we had any means of getting at the statistics on this point for all our county and city asylums, and so could include the good and the bad, as is done in England, we probably should not have good reason to be proud of the result. A careful comparison of English with American state and corporate asylums leads the writer to the conclusion that there is not less personal kindness and care on the part of the doctors and not less gentle treatment on the part of the nurses in the latter. The accusation that the use of restraint in our best asylums is on any other than humane grounds is certainly not based upon adequate knowledge of the true facts.

* In one of the asylums included in the table on page 391, it has been lately ascertained that there were four fatal accidents which did not appear in the reports, and which are not counted.

Question of Escapes.

Another matter is worth considering, and that is whether the system of more freedom permits more escapes. On this point Mr. Wilkes says: "During the year 1875, I find that 376 escapes were registered, and on the 1st of January, 1876, there were 40,261 patients in public and private asylums in England and Wales." He further says that the great majority of the patients who escape are returned very shortly (or return themselves), sometimes in a few minutes; and the instances are very rare in which they are not retaken.

In looking over all the reports for that year of American asylums, of which I have copies at hand, I find that among 15,407 patients in 34 asylums, there were 38 escapes, *none* of whom were returned or came back themselves. Those who escaped and did come back are not recorded in the reports; so that, in this point also, the system of more freedom apparently has no disadvantage.

Dangerous persons should be carefully watched, and not allowed to escape; but the moral effect of occasionally allowing a harmless patient to wander away, and find out for himself that he must go back, is certainly not a prejudicial one.

Summary of Restraint Question.

This subject of mechanical restraint has been dwelt on at some length, because it has lately excited a great deal of attention. Both here and abroad, a great many exaggerated and untrue statements have been made, and these have been copied and commented upon, giving rise to a great deal of misunderstanding; a matter which cannot be put in better form than by quoting from a recognized English authority, who says, in a private letter recently received: "I received the Journal of Medical Sciences, and have no reason to complain of being misquoted, but the gist of my argument, the writer failed to appreciate. I took up my parable against the intolerance of non-restraint advocates certainly, because they are in the majority in this country, but I meant it equally to apply against intolerance on the part

of advocates of restraint. Now, that article is as intolerant on one side as anything that has ever been written or said on the other side in this country, and the writer omitted to state that I, who had never employed restraint, was the advocate of tolerance towards those who are opposed to me. Moreover, the arguments in favor of restraint are only a *réchauffé* of what used to be said in this country by the opponents of the abolition of restraint.

"I admit some amount of force in the argument about the American people being less easily controlled, or, I should say, less amenable to discipline, than the inhabitants of this country; but, for that reason, I should apprehend they would feel the degradation of restraint all the more keenly. On the subject of American patients, I am not speaking without some knowledge, as I frequently have them in this asylum; and, what is still worse, according to my experience, Irishmen who have returned from America, and who, as usual, have acquired the vices (if I may so term a repugnance of discipline) of the people amongst whom they have lived, without acquiring their virtues.

"I have been in the habit of thus classifying, mentally (*i. e.*, in my own mind), my Irish patients: (1.) The recent imports, who are generally docile and manageable; (2.) Those who have lived some time in Liverpool or other manufacturing towns, and who have lost all their native docility and acquired the vices of their Saxon neighbors without having also developed their self-reliance; (3.) Those who have returned from America, who kick against discipline of any kind. . . . To return to the subject of restraint, I think I may assert that if it can be dispensed with in this asylum, it can be anywhere; for a more degraded, lawless class than are sent here, are not to be found in this country. . . . I do *not* think that the leading superintendents in this country favor restraint; no doubt sentiment leads many men very far in theory, but I really believe that, in England, the restraint men are in a small minority."

In our country, alienists look upon the use of mechanical restraint as a purely medical question; but there are so many other interests, social and moral, connected with it,

that Dr. Bucknill is undoubtedly right in saying that "it is a matter upon which persons who are not scientific will eventually insist upon having much to say, unless it be definitely settled beforehand." In some of the best English, and also in some of the best American, asylums, the *principle* is essentially alike; namely, to use mechanical restraint only when the interest of the patient demands it.

The *practice* is widely different in the two countries in this respect. One physician in England, for instance, who treats about forty patients of all degrees of severity in his asylum, and who uses mechanical restraint when he deems it best for the patient, wrote February 6, 1875, that he was then using it for the first time in twenty years, and oddly enough in two cases. Generally speaking, the amount used in that country is very small indeed.* In the United States, there has been a progressive improvement in the last five years; nor can there be any doubt that there will be a still less amount of restraint used, and that the methods found so successful elsewhere will be more generally adopted after they have become fully known. At the present time, the use of mechanical restraint in some of the American asylums is excessive, but not more so than is common on the continent of Europe.

This marked difference of interpreting the needs of each case, with reference to the requirements of humanity in the use of mechanical restraint, has caused a great deal of misunderstanding, in this country, of the position of English superintendents; so that they have been thought by persons not thoroughly informed, to say much more than they really mean when recommending mechanical restraint where the necessities of the case demand it. In the same way, our superintendents are thought in England to use it more than they really do.

The English county asylums, filled with inactive paupers, cannot fairly be placed in full comparison with our state asylums, overcrowded, insufficiently supplied with attendants, and provided for a less manageable class of patients; †

* Compare the statement of Mr. Wilkes, page 388.

† It should be remembered that the asylums at Perth and Broadmoor for the criminal lunatics remove that class, which (except in New York) must be treated in our ordinary asylums; that the large English asylums are mostly for paupers; and that the more intelligent classes are generally treated in private asylums.

but this fact of itself does not render the non-restraint system inapplicable to us, nor prove that it is not the best. Perhaps we shall find the "golden mean" somewhere between the practices of the countries, but nearer the English side.

An illustration of the principle of non-restraint was shown at one asylum in England, where there were padlocked guards over the fireplaces, which also had been covered with wire netting, through which a patient, in the absence of attendants, passed a long taper, lighted it, and killed herself by setting fire to her clothes. The superintendent had all the fireguards taken away, the attendants found that they must look after the patients, and no similar accident occurred again.

RESPONSIBILITY FOR CRIME,* AND DEFINITIONS OF INSANITY.

It would be an interesting study to follow the gradual development of rational views on the part of the community with regard to mental disease, but it is not necessary here. It corresponds very nearly with general intellectual development.

Until about the beginning of the present century, Lord Hale's principle was held by the courts, that to be exempted from punishment on the ground of insanity, a man must be deprived of all memory and understanding, and no more know what he is doing than an infant, brute, or wild beast. Delusion, of which the criminal act was the direct offspring, was the next test; and then the *general* power of distinguishing right from wrong. A little before the middle of this century, the *particular* knowledge of right and wrong at the time the criminal act was committed was laid down by the judges as the criterion of responsibility. Under this decision, an insane man would be held exempt from punishment if he killed another man whom, by virtue of his delusion, he supposed to be making a mortal attack upon himself; if he supposed that some great injury only was to be done to him, murder com-

* This is touched upon here only very briefly, as a matter of necessity. The general reader is referred for further information to Ray's "Medical Jurisprudence" and "Contributions to Mental Pathology," to Maudsley's "Responsibility in Mental Disease," and to the last edition of "Casper's Forensic Medicine."

mitted under this delusion would render him liable to punishment, while, at the same time, he could not legally make a will. This illogical position is not now generally held in this country, and some recent decisions have been made in conformity with more rational views; but that criminals should occasionally be acquitted on the ground of insanity, and that persons evidently insane should suffer judicial murder, may be unavoidable so long as there can be no definite line drawn between sanity and insanity. The recent decision by which Kullmann, who attempted to assassinate Prince Bismarck, was acquitted of deliberate attempt to murder, on the ground of limited responsibility arising from hereditary defect,—although he was in no sense insane,—may be fairly considered far in advance of any other judgment of modern times. In striking contrast with this, is a late English decision.* A patient, an insane epileptic in one of their asylums, killed an attendant. At the trial, the judge held that—

“Where a man committed crime for some supposed grievance, if he knew that what he was doing was contrary to law, he was to be held responsible for his actions. If a man killed another while under delusion that he himself was about to be killed, and that he was acting in self-defence, he would not be punishable; but if a man did so for some supposed injury to his character or fortune, then the man would be responsible. . . . If the jury were satisfied that, although Fordham was suffering from delusions, he knew what he was doing, and was not merely taking life under an erroneous impression that he was defending his own life, but killing because he felt himself injured in some form or other, it would be their duty to find him guilty.”

Fordham was declared guilty and sentenced to be hanged, but there was afterwards commutation to penal servitude for life. The superintendent of the asylum in which Fordham was confined was one of those who thought him responsible. The question of self-control apparently was not considered.

The Commissioners in Lunacy (a board in which there are three physicians and three lawyers who visit the asylums)

* Thirtieth Annual Report of the Commissioners in Lunacy, London, 1876, pp. 40 and 41.

recommended, in 1873 (and there is no dissent expressed in their report on the part of any members), that a patient in one of their insane asylums, who had committed murder while there, should suffer the full penalty of the law.* Some years before this, an attendant was convicted in court and sentenced on the sole evidence of an insane patient.

In this connection, it is proper to say that the English criminal code is very much more severe than ours; and it is natural, therefore, that their limitations of responsibility should be less favorable to all offenders against society.†

Regarding the criminal, insane or not, from the humane point of view, our own country, during the past century, has made greater progress than this, as have also France and Germany.

So long as insanity was considered a disease of an immaterial mind, a *seelenstörung*, the greatest confusion existed in defining it. One of Esquirol's pupils described‡ it in 1817 as "a want of control of our feelings and propensities." Haslam, in 1832, testified in an English court that he had never seen a sane person; saying, too, "I presume the Deity is of sound mind, and he alone."

A little later, the capability of repeating the multiplication-table was gravely propounded in an English court as a test of insanity in a case involving a large sum of money. In 1837, Browne, in his lecture on *What is Insanity*, says that its definition is an enigma which Œdipus could not have solved.

With the clinical study of mental disease in the European schools; and with the impulse given to scientific research by careful autopsies, the immaterial theory of insanity has disappeared. In 1854, in an essay on *Unsoundness of Mind* in

*Twenty-eighth Report, 1874, page 2.

† In Blackstone's time, for instance, there were one hundred and forty capital offences. Judges now sentence boys of twelve to a dozen lashes for such offences as throwing stones at railroad trains. The penalty for unlawfully destroying or damaging "any statue or monument exposed to public view" is whipping, if the offenders are under sixteen years of age; for highway robbery with violence judges may, at their discretion, and often do sentence to imprisonment, with or without a certain number of lashes in addition.

‡ *Management of Lunatics, with Illustrations of Insanity*. By George Parkman, M. D. Boston, 1817.

Relation to Criminal Acts, to which the first Sugden prize was awarded, Dr. Bucknill describes insanity as "a condition of the mind in which a false action of conception or judgment, a defective power of the will, or an uncontrollable violence of the emotions and instincts have separately or conjointly been produced by disease." Two recent definitions illustrate still greater advance, and the difference in twenty-two years is well worth noting:—

"Insanity is, in fact, disorder of brain, producing disorder of mind; or, to define its nature in greater detail, it is a disorder of the supreme nerve-centres of the brain,—the special organs of mind,—producing derangement of thought, feeling, and action, together or separately, of such degree or kind as to incapacitate the individual for the relations of life. . . . Mind may be defined physiologically as a general term, denoting the sum-total of those functions of the brain which are known as thought, feeling, and will. By disorder of the mind is meant disorder of these functions." *

"Insanity consists in morbid conditions of the brain, the result of defective formation or altered nutrition of its substance, induced by local or general morbid processes, and characterized especially by non-development, obliteration, impairment, or perversion of one or more of its psychical functions." †

"Disorder of brain" and "morbid conditions of the brain" are such general terms as to include all conditions, even those usually called reflex, giving rise to insanity; but the definitions also embrace too much, for they clearly include the delirium of starving, drunkenness, and of many of the acute febrile conditions as well of the brain as of other organs. No one, for instance, would be justified in calling the raving of brain fever or pneumonia insanity, and yet the conditions (as defined above) of irresponsibility exist. It has been proposed to get over the difficulty by limiting the word insanity to permanent disorders of the cerebral faculties, carefully avoiding even the expression in transient attacks. If this could be done, a great gain would be got in

* Responsibility in Mental Disease. By Henry Maudsley, M. D. International Series. New York, 1874.

† Dr. J. Batty Tuke in the Edinburgh Medical Journal, November, 1874.

many ways; for there are many forms of mental disease of short duration, pursuing a definite course and self-limited, like typhoid fever, in which the recovery is complete, and in which the purely physical symptoms are very slight. Again, in the recurrent forms of "insanity," with entirely healthy intervals, there are many reasons for supposing that we deal with successive attacks of a malady, where, as in bronchitis, the diseased organ recovers wholly its tone, rather than with a fixed malady like syphilis, where, even with quite long intervals of apparent health, the disease cannot always be said to be cured, beyond possibility of reappearance or of transmission to offspring, until death.

Still, if the above definitions, unsatisfactory as they are, could be insisted on, many of the disputes between the lawyers and the doctors would settle themselves. Men trained in medicine and in exact scientific observation would then testify as to the pathological condition of a given individual whose sanity is questioned, and other men, trained in a different way and accustomed to take a broader view of social questions, would decide as to the limitation of responsibility.

MASSACHUSETTS STATISTICS AND ASYLUM ACCOMMODATION.

The number of the insane known to the officials and under the care of the State increases from year to year in all countries. We have no absolute statistics, by which we can say how far this increase is apparent and how far it is real; that is, whether the actual proportion of recent cases to the population is greater from year to year. The life-saving influence of better medical skill, and the more humane views of the people at large, have undoubtedly tended to very much prolong life in chronic diseases. We do not now leave the sick and the lame by the wayside to die. The natural result is, that there are more invalids of all classes, many of whom marry unwisely and beget debilitated offspring to still further increase the number.

The following table shows the number of the insane in our asylums in Massachusetts at the end of each year since 1820, and the rate per 100,000 of the population for the census years :—

YEARS.	Patients at end of year.	Patients per 100,000 of the population.	YEARS.	Patients at end of year.	Patients per 100,000 of the population.	YEARS.	Patients at end of year.	Patients per 100,000 of the population.
1820, . .	50	9.55	1839, . .	337	-	1858, ⁴ . .	1,131	-
1821, . .	28	-	1840, ² . .	457	61.99	1859, . .	1,205	-
1822, . .	42	-	1841, . .	476	-	1860, . .	1,361	110.55
1823, . .	54	-	1842, . .	474	-	1861, . .	1,503	-
1824, . .	51	-	1843, . .	495	-	1862, . .	1,497	-
1825, . .	54	-	1844, . .	530	-	1863, . .	1,557	-
1826, . .	55	-	1845, . .	632	-	1864, . .	1,403	-
1827, . .	57	-	1846, . .	667	-	1865, . .	1,412	111.44
1828, . .	69	-	1847, . .	723	-	1866, ⁵ . .	1,643	-
1829, . .	65	-	1848, . .	752	-	1867, . .	1,752	-
1830, . .	69	11.34	1849, . .	816	-	1868, . .	1,846	-
1831, . .	68	-	1850, . .	845	84.97	1869, . .	1,824	-
1832, . .	64	-	1851, . .	898	-	1870, . .	1,901	130.44
1833, ¹ . .	181	-	1852, . .	977	-	1871, . .	1,923	-
1834, . .	198	-	1853, . .	979	-	1872, . .	1,942	-
1835, . .	196	-	1854, ³ . .	1,071	-	1873, . .	1,996	-
1836, . .	209	-	1855, . .	1,029	90.87	1874, . .	2,134	-
1837, . .	271	-	1856, . .	1,082	-	1875, . .	2,195	182.88
1838, . .	311	-	1857, . .	1,082	-			

¹ Worcester Asylum opened. ² South Boston Asylum opened. ³ Taunton Asylum opened.
⁴ Northampton Asylum opened. ⁵ Insane department in almshouse at Tewksbury opened.

The next table shows for each year since 1832, the number of admissions to our asylums (excluding transfers) and the number of *acute cases*; *i. e.*, those who had been ill not over a year. This latter division is not perfect, but is sufficient for

YEARS.	Admissions.	Acute Cases.	YEARS.	Admissions.	Acute Cases.	YEARS.	Admissions.	Acute Cases.
1832, . .	94	44	1847, . .	488	275	1862, . .	693	344
1833,* . .	256	91	1848, . .	490	247	1863, . .	697	344
1834, . .	237	115	1849, . .	511	251	1864, . .	686	332
1835, . .	196	104	1850, . .	487	267	1865, . .	674	345
1836, . .	231	99	1851, . .	519	252	1866,* . .	890	427
1837, . .	288	137	1852, . .	506	265	1867, . .	976	431
1838, . .	315	149	1853, . .	474	227	1868, . .	920	452
1839, . .	311	155	1854,* . .	593	309	1869, . .	968	510
1840,* . .	442	165	1855, . .	586	280	1870, . .	1,108	516
1841, . .	367	182	1856, . .	627	352	1871, . .	1,121	712
1842, . .	377	206	1857, . .	662	377	1872, . .	1,138	686
1843, . .	398	205	1858,* . .	673	344	1873, . .	1,088	587
1844, . .	424	242	1859, . .	749	378	1874, . .	1,144	556
1845, . .	433	230	1860, . .	817	438	1875, . .	1,102	610
1846, . .	469	263	1861, . .	846	412			

our present purpose. The years in which new asylums were opened are marked with an asterisk. For the eight successive quinquennial periods, beginning with 1836, the proportions of acute cases to admissions have been 44.42, 53.28,

53.29, 49.74, 53.54, 49.42, 47.96, 56.34. The acute cases from the South Boston Asylum are not included in the last twenty years, as there were no records by which they could be readily got; they would make the percentage of acute cases slightly greater for the last four quinquennial periods.

We cannot, indeed, say definitely just how much influence this conservation and prolongation of life has in increasing the number of our insane; and the cure-rates in asylums are estimated on such different bases by different individuals, and our statistics are otherwise so incomplete, that we should not learn much from considering them with reference to this point. But it is clear that the number of curable cases existing in the State is less in proportion to the whole number from year to year. On the other hand, under the influence of increased confidence on the part of the public, a larger part of the insane of all classes are admitted to our asylums each year, while the incurable cases accumulate, so that the ratio of recoveries *seems* less; and this fact explains many otherwise puzzling statistics of our insane asylums.*

If this view be correct, the annual rate of increase must at some time diminish and finally cease to be anything; and "it is worthy of remark that the total increase of the past year [1875] over the preceding one has been less than in any other year" since 1859 in England,† covering the period (eighteen years) during which full statistics have been kept. Perhaps the extreme point has been reached there.

According to Dr. Jarvis's accurate and exhaustive report to the Legislature in 1855, there were then in Massachusetts, 2,632 insane and 1,087 idiots, with a population of 1,132,369. By the census of Massachusetts, in 1875, there were 3,637

* A good illustration of this fact is found in the statistics of the only insane asylum in Maine for the three decades and a half of its existence, from 1840 to 1875, where the increasing death-rate and diminishing cure-rate indicate the change in the character of the patients admitted and treated:—

T I M E .	Number of Patients Admitted.	Proportion of Cures to Admissions.	Proportion of Deaths to Admissions.
First decade,	1,064	42.10	7.80
Second decade,	1,185	40.75	17.80
Third decade,	1,374	40.32	23.28
Fourth period, one-half decade,	953	36.41	25.81

† Thirtieth report of the Commissioners in Lunacy, page 2.

insane and 1,340 idiotic—with a population of 1,651,912. During the year 1875, there were about 3,800 insane reported to the Board of State Charities, so that the numbers in the census returns must fall somewhat short of the truth.

By Dr. Jarvis's statistics there was one insane person to every 430 of the population; by the census of 1875, not so many; namely, one in 454. If the ratio were the same as in 1855, our present number of the insane would be 3,842. It can hardly fall far short of 4,000.

September 30, 1875, there were 2,722 under the supervision of the Board of State Charities:—

In state hospitals,	1,842
corporate and private and county hospitals,	441
the workhouse,	46
the state prison,	2
At Monson,	1
In the care of overseers of the poor outside of hospitals,	890

All of our state hospitals are crowded, and considerably less than half of our insane can be treated in them, even in that condition, while we are building two new asylums, which will, by crowding, accommodate at most 1,000 more. When these are finished we shall have provision by the State for about 2,600, or nearly two-thirds of our insane, without overcrowding. The McLean Asylum and the City Asylum at South Boston will accommodate together nearly 400; so that, if hospital provision is needed for three-fourths* of our insane (or 3,000), the State really needs to provide for 2,600; to do which, even if we do not allow for any increase in the numbers to be cared for in institutions, the old asylum at Worcester and at South Boston will probably be needed, unless we adopt some new plan of provision for the insane. Otherwise, the wards of our asylums will soon be filled to overflowing; and this overcrowding, to be found pretty much over our whole country, increases excitement in the patients, and renders their classification and management much more difficult. Massachusetts is as well provided as any State, probably, in this respect; and yet there are now in our

* This is somewhat less than are provided for in Scotland and England in asylums and departments for the insane of workhouses.

asylums 500 more patients than can be properly accommodated in them.

Very few of our States, indeed, have provided sufficient hospital accommodation for their insane, and we may well take a lesson from their experience. In regard to this point, Dr. Mark Ranney, the well-known superintendent at Mount Pleasant, Iowa, writes :—

“In every State in the Union, the attempt or prevailing custom of keeping the common or ordinary pauper and the insane in the same poorhouse, with the prevailing want of proper separation and classification, has been a scandal and a reproach.

“The fact that the two hospitals for the insane in this State, with a capacity suitable for only 550, contain to-day about 865 patients, while there are at least, or not far from, 1,200 insane, is of itself sufficient evidence that there are not adequate provisions for the insane in this State. In this particular, however, I do not suppose we are much behind many or most other States, the newer as well as the older. Like some other States, Iowa has provided for the building of a very expensive hospital,—unnecessarily expensive in my opinion,—now about half completed, which will cost about \$1,000,000, or about \$2,000 per patient.

“I apprehend that this great outlay will have the effect, as similar outlay elsewhere has had, in the opinion of some, to prevent adequate provision being made of a cheaper but in every way suitable character. It has long seemed to me very inconsistent to provide so expensively for one-half of the insane and doom the other half, equally deserving, to poorhouses or receptacles that at the best are no better than they should be, or to severe struggles with want and privation in the hands of their friends. I have yet to see reason to believe that a hospital costing \$2,000 per head will be more conducive to the recovery of patients from insanity than one costing only \$1,000, or even less.”

Dr. Andrew McFarland of Illinois, an alienist of large experience, says :—

“The history of the relation of the State to the insane here is soon told, and probably has its counterpart in most other States. In 1847, Miss D. L. Dix, after extensive exploration, drew a most appalling picture of the condition of the insane in the State, which she embodied in a memorial to the Legislature. The establishment of a state hospital followed, which was opened in 1851. But it filled up at once, with no perceptible relief to the accumulating mass.

The State was slow in proceeding further, and soon the picture of 1847 might have been drawn in even darker colors. By 1867 the accommodations were doubled, *and still no relief*. We now have three state hospitals, first-class in size, with a county asylum near Chicago, equal in capacity; yet with all this, we *get no apparent relief*. It is not surprising that intelligent legislators ask, 'How long is this to go on, and are you sure your lead is in the right direction?'"

Dr. C. F. McDonald, superintendent of the asylum for the criminal insane at Auburn, N. Y., writes:—

"'Overcrowded' seems to be the fixed condition of almost every insane hospital in the country. In looking over the reports of American institutions for the insane, one is struck with the fact that in almost none is the subject of overcrowding not considered. In fact, allusion to the topic is so common, that I have come to doubt if we shall ever see the time when we can say, 'Our provisions for our insane population are adequate.'"

And Dr. A. Reynolds, of the state asylum at Independence, Iowa, adds:—

"No state west of the Alleghanies has adequate hospital capacity for her insane. Until hospitals are built at a less cost per capita than \$1,000, it is useless to talk of providing for all the insane of the State."

SUPERVISION BY THE STATE.

Committal to Asylums.

The late Dr. Samuel G. Howe, after twenty years' official relation with some of our public establishments for the insane, and after ten years' experience as visitor to all the state hospitals of Massachusetts, said: * "All human institutions are, of course, liable to abuse, but our Massachusetts hospitals for lunatics are as well guarded against them as any public establishments with which I am familiar"; and again, "there are rather too many than too few difficulties in the way of committal" of patients to insane asylums in our State.

Although a different position is held in the report of the commissioners of lunacy, appointed for a single year, who

* Boston Daily Advertiser, March 22, 1873.

reported to the Legislature, January, 1875, there are no facts given there in support of that opinion; but recent investigations at Tewksbury and at Westborough seem to indicate that there is fault either in the laws or in their execution.

Improper Committals.

It has been urged before our legislatures, that many persons insane and not insane are improperly confined in our asylums, and that many complaints are made by patients which could best be attended to by an impartial commission.

As to improper confinements, our superintendents have testified that they are rare, soon discovered, and promptly set right. They must occur occasionally, so long as human judgment is fallible, but no wisdom or foresight can always prevent them. The very professor of mental disease, some years ago, in one of the first German universities, with the benefit of a consultation of the hospital staff, was committed to an insane asylum when suffering from typhoid fever.

In looking over a pile of American reports, the first two in which I find any mention of this point are from Utica, N. Y., and Dixmont, Penn., justly considered as among our best institutions. In the asylum at the former place, of 11,831 patients admitted from 1843 to 1875, 175 were found not to be insane. Of 2,981 consecutive admissions at Dixmont there was no insanity in ten cases. But in all these cases, which included dipsomaniacs, opium-eaters, and others suffering under some form of delirium, there was not one of intentional deception or illegal committal.

In some forms and degrees of mental disease, no more perplexing questions come before the expert than *whether* to send to asylums, *when* to send to asylums, and *when* to advise removals; and here there is room for very wide differences of opinion. The only thing we can do is to provide as many safeguards as possible, the greatest of which is in the high character of our superintendents. These men should have large powers, duly guarded, should be held to a strict accountability, and should be trusted by the officers of the State, in order that they may get the confidence of their patients.

More or Better Supervision Needed.

Without maintaining that, with all the supervision now got by the patients in our Massachusetts asylums, there is need of another commission to still further protect their rights (a need which is now urgently felt in some of our States), it can hardly be doubted that great benefit would arise from more system and better methods in such inspection. The advantages of well-organized supervision cannot be better stated than in the experience of a State which has already tried the experiment. By a law passed in 1876, all the asylums (of all kinds) in Kansas were placed under one board of trustees; and in their report on the insane asylum at Ossawatimie, they say,—

“It gives a uniform direction to their management; . . . it enables them to compare the advantages and disadvantages of the different systems of management, and to abolish the evil and ingraft the good features thereof into each to their benefit; it occasions a close scrutiny of the condition and requirements of each, . . . and it has resulted in a large reduction of the expense.” *

One of the most distinguished alienists in England said, after carefully visiting thirteen of our asylums, and studying our customs pretty thoroughly,—

“Unless I am much mistaken, the superintendents of asylums in America have a heavy task before them, which will indeed require a determined effort before they can say that they possess the confidence of the public in the same degree to which of late years it has been extended, in England, to the management of our county asylums and hospitals for the insane. With us, the management of our asylums is open and patent. Abuses occur, as they will occur everywhere; but they are remedied, and, if need be, punished in the most public manner, and the records of them are displayed to the world.” †

Uses of a Commission.

There are many particulars, indeed, beyond protection of the rights of the insane, in which a properly constituted commission, if wisely selected, might be of use, especially in collecting facts and diffusing information for the use of the

* The asylum now building at Topeka for the insane will cost less than one-fourth as much per patient as some of those recently built in other States.

† The Lancet. London, 1876.

public; for insanity is, as Sir James Coxe says, a disease of ignorance; and our chief reliance in arresting its progress must be in an increase of knowledge among those who may be considered liable to it. The public has the right, too, of knowing just how asylums are conducted; and the fact that the affairs of all of them were to be open to inspection, would tend to increase popular confidence in their management.

False Position of American Association.

The American Association of Superintendents have opposed lunacy commissions. They refer to the humiliating story of our Indian commissions, etc., and think that such a body as is likely to be appointed at Washington would be of negative use, or do at least as much harm as good,—an argument which, unfortunately, must be acknowledged to have very great weight. They assume, too, that the State would do unwisely to interfere with the absolute control, which they think superintendents of insane asylums should have over those committed to their charge. They say: *—

“If the time shall ever come when the Legislature, in its zeal for the public good, shall establish a board of officers to supervise the medical practice of the State, with power to enter every sick man’s chamber, to inquire respecting the medicine and diet prescribed, and any other matter connected with his welfare, and report the results of their examination to the constituted authorities, then it may be proper to consider the propriety of extending the same kind of paternal visitation to the hospitals for the insane.”

Whatever opinion we may have as to the necessity of governmental supervision, there can never be any analogy between the two cases until our laws are very different from those now in force. A sick man, in his chamber, is surrounded by his dearest friends and relatives, who sacrifice their own comfort to his needs. In the asylum, his wants are administered to exclusively by those who are paid to do so; he cannot select his physician, he cannot change his nurse, he cannot order his food or discharge his cook, and often does not communicate with his friends for many weeks.

It is difficult to conceive that such a position could be taken, except from a very narrow standpoint, and with an undue

* Resolutions, 1874.

sensitiveness as to public opinion. It would not be likely, for instance, in a society like the British Medico-Psychological Association, composed of medical superintendents, assistant physicians in asylums, physicians in general practice, justices of the peace, and lawyers.

Complaints of Discharged Patients.

The complaints of discharged patients and of patients in asylums, if investigated by a fair commission, might be more satisfactorily disposed of than at present, and would often relieve the superintendents of undeserved censure. To give full and not undue weight to such complaints would require an intimate knowledge of mental disease, and a familiarity with the history of the complainant which the public cannot get. They are often plausible, frequently trivial, and arouse the sympathies of philanthropic people to a degree not always proportionate to their importance, although sometimes far otherwise. The really sensible criticisms which one gets on our asylums come chiefly from persons who have recovered, and who avoid rather than seek notoriety.

For the purpose of considering the bearing of this question, discharged patients may be classified as follows: 1st. Those who have recovered, and whose minds were clear enough, during a considerable part at least of their illness, to have received clear impressions of what was going on about them, and who have remembered with tolerable accuracy,—by no means an insignificant number. 2d. The same as the above, except that they have not remembered. 3d. Those who have recovered, and whose minds were absolute blanks during the time of their severe illness, so that they remember absolutely nothing of that time, and more or less imperfectly of their period of convalescence. 4th. Those who have recovered, and whose impressions during a large part of their residence in the asylum were more or less tinged by their own delusions; of whom some finally recognize the delusional character of their previous ideas, and others never do so, although in other respects perfectly well.

There are four other classes corresponding to these, with the single difference that they have never recovered.

It would be very unjust and untrue to say that there are not many discharged patients from insane asylums whose testimony and general statements are fully as trustworthy as those of other people. But there are many others also, from whose minds the false impressions once made are not removed, and it is often a matter of the greatest difficulty for even an expert to decide between the two.

The superintendents of the asylums might easily dispose of many loud accusations and complaints by publishing a few pages from their records, and showing to the public the real facts in such cases. This, however, their sense of honor forbids their doing, for their patients' secrets are held by them as a sacred trust.

The impression which is sometimes given, that the mere fact of a discharged patient's making complaints or criticisms in regard to asylum management is *ipso facto* evidence of incomplete recovery, and that those entirely well always speak favorably of everything that happened to them during their illness, does not need consideration here.

Best Supervision.

The best supervision consists in frequent visits of friends of patients, and this has lately been done to a great extent, particularly in asylums of the McLean type, although begun and extensively adopted nearly twenty years ago under Dr. Walker at the South Boston Asylum, and now considered by many of our superintendents as one of the most important points to be thought of in locating new asylums. Dr. Clouston of Edinburgh thus speaks of this important matter in his report for 1875 :—

"We are in this peculiar and almost unique position in Scotland, that while our number of yearly admissions increases, our numbers left at the end of the year have diminished for the past three years. There are several causes for this. Our recoveries are very numerous, and a large number of unrecovered but quiet cases are removed, at my advice, by their friends. Our proximity to town and the extraordinarily ready access provided by the tramways are instances which most people, and among them many high as in lunacy matters, would consider great disadvantages."

is to bring the relatives of our poorer patients out to the asylum to visit them, to an extent quite unknown in country asylums. In this way, an interest in them is kept up, and very few of them indeed are forgotten and neglected by their kith and kin. This is an influence which often saves them from falling into incurable insanity; it gives many of them unbounded pleasure, it keeps alive home feelings and associations, and it brings a direct public opinion of the most unsleeping and critical kind to bear on the officers and attendants of the institution—all matters of incalculable importance and much difficulty of attainment.

“When the relatives see that the acute symptoms have passed off, they are often disposed to take them out for a day or two to see how they get on. If this succeeds they try them at their usual employments, and, if they do well, are often anxious to have them home altogether. It is by this most natural of all means that any undue accumulation of the incurably insane has been avoided for the past three years, and the problem of how to provide for such, which is so urgent in many parts of the kingdom, has been solved for us at no cost to the rates whatever. I find from the report of the commissioners in lunacy that Edinburgh is the only county in Scotland the majority of whose population is urban, where the numbers of the registered insane, whether in asylums or not, have absolutely diminished for the last three years.”

. Another beneficial result of this frequent visitation is noted in higher standards of excellence, and consequently increased confidence of the community. In commenting on the fact that 1,026 patients were treated in the year passed (1875), *without the occurrence of a single suicide, untoward accident, or case of epidemic disease*, although extensive alterations in the asylum were making, the report continues:—

“In addition to the requisites of a good ordinary hospital, in the way of light and air, ventilation and cheerfulness, sanitary apparatus and baths, and convenience of administration, we require extended and varied means of occupation and amusement, day-rooms, dining-rooms, and workshops of all kinds, extensive gardens and farms, pleasure-grounds, and billiard-rooms, etc. The extreme importance of the curative aspect of the institution, as distinguished from its boarding-house character, is *amply attested by the enormous and increasing number of admissions of recent cases.*”

This statement may well be considered carefully, where decreased confidence on the part of the community is com-

plained of as a cause of fewer admissions of acute cases.* Can we not, too, in some such way, reduce the accumulation of chronic cases in our public institutions and diminish that unfortunate class described by Maudsley as "asylum-made lunatics"?

Good Asylums, as a Rule, Better than Homes.

The first patient admitted to a Massachusetts insane asylum was a person brought by his own father, who thought the young man to be possessed of a devil, and whose treatment consisted in whipping him. From that day to this, although the ideas of the people have very much changed and more enlightened views prevail, no one familiar with the insane can, I think, for a moment doubt that they often are treated with more uniform consideration and kindness in our best asylums than by their own friends in their own homes. Individual and striking illustrations of this statement are constantly brought under the observation of the officers of asylums.

It is the opinion of asylum superintendents, too, almost universally throughout the country, that, taking all things into consideration, treatment in an asylum gives the most chances of a cure † in the majority of cases, in spite of the fact that, as they are now constructed, the good of the individual must be occasionally sacrificed to conform to requirements deemed necessary for others, but not needed by him.

We must not think, however, that an asylum, as now existing, is the only thing possible or the best thing practicable in

* The fact is that the two are not necessarily at all connected. If the community simply learn to trust asylums more, they will send more of their friends to them, until they are full; if they learn, also, that the chief object of the asylum is curative, that the wards are not crowded to excess with inmates who would be better off elsewhere, and that the idea in treatment is to keep people out of asylums, as far as is practicable, they will act accordingly.

† This opinion is, of course, entitled to great weight; but the statistics upon which it is sometimes based do not prove the fact. It is stated, for instance, that of those who enter an asylum early, from seventy to ninety per cent. are cured, and in a short time; while the others are incurable just about in proportion as their friends delay sending them to asylums. If, in similar way, we grouped all pulmonary diseases together, we might prove that a large proportion of cases of pleurisy and lung fever get well because the symptoms in those diseases are early severe enough to make hospital treatment or rest in bed necessary, and that consumptives never get well because they never seek hospital treatment until progressive weakness compels them to do so, or until the disease is far advanced,—a manifest *reductio ad absurdum*.

all cases. Florence Nightingale, in 1876, summed up her great experience in these words, "Hospitals are but an intermediate stage of civilization. At present, hospitals are the only place where the sick poor can be nursed, or, indeed, often the sick rich. But the ultimate object is to nurse all sick at home." Sir James Simpson devoted the ripest years of his life to opposing the agglomeration of disease of all kinds. Sir James Cox, after forty years' active work in the medical profession, and nearly twenty years on the lunacy commission of Scotland, attaches no therapeutic value to insane asylums, but regards them simply as conveniences. Professor Meynert tells the physicians from all parts of the world, who listen to his lectures in Vienna, that something is lost in all cases although more is generally gained, in sending an insane person to an asylum. Maudsley, Blandford and others treat even some of the most violent forms of mental disease in private houses in those rare cases when the circumstances, surroundings and associations of their patients are such that they can command anything that is needed for their proper treatment; and cures are often more rapid thus. The cases are decidedly the smaller number, however, where home treatment of insanity can be recommended, and the points in which our asylums excel are growing more from year to year.

Project of a Law.

The American Association of Superintendents, a half-dozen years ago, prepared a project of a law, which has become a statute in Pennsylvania, giving their views upon this general question. So far as they go they are admirable, and are given here entire as dealing with an important subject:—

"The Association of Medical Superintendents of American Institutions for the Insane, believing that certain relations of the insane should be regulated by statutory enactments calculated to secure their rights and also the rights of those intrusted with their care, or connected with them by ties of relation or friendship, as well as to promote the ends of justice, and enforce the claims of an enlightened humanity, for this purpose recommend that the following legal provisions be adopted by every State whose existing laws do not already satisfactorily provide for these great ends:—

"1. Insane persons may be placed in a hospital for the insane by their legal guardians, or by their relatives or friends, in case they have no guardians; but never without the certificate of one or more reputable physicians, after a personal examination, made within one week of the date

thereof; and this certificate to be duly acknowledged before some magistrate or judicial officer, who shall certify to the genuineness of the signature, and to the respectability of the signer.

"2. Insane persons may be placed in a hospital, or other suitable place of detention, by order of a magistrate, who, after proper inquisition, shall find that such persons are at large, and dangerous to themselves or others, or require hospital care and treatment, while the fact of their insanity shall be certified by one or more reputable physicians, as specified in the preceding section.

"3. Insane persons may be placed in a hospital, by order of any high judicial officer, after the following course of proceedings, viz.: On statement in writing, of any respectable person, that a certain person is insane, and that the welfare of himself, or of others, requires his restraint, it shall be the duty of the judge to appoint, immediately, a commission who shall inquire into and report upon the facts of the case. If, in their opinion, it is a suitable case for confinement, the judge shall issue his warrant for such disposition of the insane person as will secure the objects of the measure.

"4. The commission provided for in the last section shall be composed of not less than three, nor more than four persons, one of whom, at least, shall be a physician, and another a lawyer. In their inquisition they shall hear such evidence as may be offered touching the merits of the case, as well as the statements of the party complained of, or of his counsel. The party shall have seasonable notice of the proceedings, and the judge is authorized to have him placed in suitable custody while the inquisition is pending.

"5. On a written statement being addressed by some respectable person to any high judicial officer, that a certain person, then confined in a hospital for the insane, is not insane, and is thus unjustly deprived of his liberty, the judge, at his discretion, shall appoint a commission of not less than three, nor more than four persons, one of whom, at least, shall be a physician, and another a lawyer, who shall hear such evidence as may be offered touching the merits of the case, and, without summoning the party to meet them, shall have a personal interview with him, so managed as to prevent him, if possible, from suspecting its objects. They shall report their proceedings to the judge, and if, in their opinion, the party is not insane, the judge shall issue an order for his discharge.

"6. If the officers of any hospital shall wish for a judicial examination of a person in their charge, such examination shall be had in the manner provided in the fifth section.

"7. The commission provided for in the fifth section shall not be repeated, in regard to the same party, oftener than once in six months; and in regard to those placed in a hospital under the third section, such commission shall not be appointed within the first six months of their residence therein.

"8. Persons placed in a hospital under the first section of this act may be removed therefrom by the party who placed them in it.

"9. Persons placed in a hospital under the second section of this act may be discharged by the authorities in whom the government of the hospital is vested.

"10. All persons, whose legal status is that of paupers, may be placed in a hospital for the insane by the municipal authorities who have charge of them, and may be removed by the same authority, the fact of insanity being established as in the first section.

"11. On statement in writing to any high judicial officer, by some friend

of the party, that a certain party placed in a hospital under the third section is losing his bodily health, and that consequently his welfare would be promoted by his discharge, or that his mental disease has so far changed its character as to render his further confinement unnecessary, the judge shall make suitable inquisition into the merits of the case, and according to its result, may, or may not, order the discharge of the party.

"12. Persons placed in any hospital for the insane may be removed therefrom by parties who have become responsible for the payment of their expenses; provided that such obligation was the result of their own free act and accord, and not of the operation of law, and that its terms require the removal of the patient in order to avoid further responsibility.

"13. Insane persons shall not be made responsible for criminal acts in a criminal suit, unless such acts shall be proved not to have been the result, directly or indirectly, of insanity.

"14. Insane persons shall not be tried for any criminal act during the existence of their insanity; and for settling this issue one of the judges of the court by which the party is to be tried shall appoint a commission, consisting of not less than three, nor more than five persons, all of whom shall be physicians, and one, at least, if possible, an expert in insanity, who shall examine the accused, hear the evidence that may be offered touching the case, and report their proceedings to the judge, with their opinions respecting his mental condition. If it be their opinion that he is not insane, he shall be brought to trial; but if they consider him insane, or are in doubt respecting his mental condition, the judge shall order him to be placed in some hospital for the insane, or some other place favorable for a scientific observation of his mental condition. The person to whose custody he may be committed shall report to the judge respecting his mental condition, previous to the next term of court, and if such report is not satisfactory, the judge shall appoint a commission of inquiry, in the manner just mentioned, whose opinion shall be followed by the same proceedings as in the first instance.

"15. Whenever any person is acquitted in a criminal suit, on the ground of insanity, the jury shall declare this fact in their verdict; and the court shall order the prisoner to be committed to some place of confinement for safe-keeping or treatment, there to be retained until he may be discharged in the manner provided in the next section.

"16. If any judge of the highest court having original jurisdiction shall be satisfied by the evidence presented to him that the prisoner has recovered, and that the paroxysm of insanity in which the criminal act was committed was the first and only one he had ever experienced, he may order his unconditional discharge; if, however, it shall appear that such paroxysm of insanity was preceded by at least one other, then the court may, in its discretion, appoint a guardian of his person, and to him commit the care of the prisoner, said guardian giving bonds for any damage his ward may commit: *provided, always*, that in case of homicide, or attempted homicide, the prisoner shall not be discharged unless by the unanimous consent of the superintendent and the managers of the hospital, and the court before which he was tried.

"17. If it shall be made to appear to any judge of the supreme judicial court, or other high judicial officer, that a certain insane person is manifestly suffering from the want of proper care or treatment, he shall order such person to be placed in some hospital for the insane at the expense of those who are legally bound to maintain him.

"18. Application for the guardianship of an insane person shall be made

to the judge of probate, or judge having similar jurisdiction, who, after a hearing of the parties, shall grant the measure, if satisfied that the person is insane and incapable of managing his affairs discreetly. Seasonable notice shall be given to the person who is the object of the measure, if at large, and if under restraint, to those having charge of him; but his presence in court, as well as the reading of the notice to him, may be dispensed with if the court is satisfied that such reading or personal attendance would probably be detrimental to his mental or bodily health. The removal of the guardianship shall be subjected to the same mode of procedure as its appointment.

“19. Insane persons shall be made responsible, in a civil suit, for any injury they may commit upon the person or property of others; reference being had in regard to the amount of damages to the pecuniary means of both parties, to the provocation sustained by the defendant, and any other circumstance which, in a criminal suit, would furnish ground for mitigation of punishment.

“20. The contracts of the insane shall not be valid, unless it can be shown either that such acts were for articles of necessity or comfort, suitable to the means and condition of the party, or that the other party had no reason to suspect the existence of any mental impairment, and that the transaction exhibited no marks of unfair advantage.

“21. A will may be invalidated on the ground of the testator's insanity, provided it be proved that he was incapable of understanding the nature and consequence of the transaction, or of appreciating the relative values of property, or of remembering and calling to mind all the heirs-at-law, or of resisting all attempts to substitute the will of others for his own. A will may also be invalidated on the ground of the testator's insanity, provided it be proved that he entertained delusions respecting any heirs-at-law calculated to produce unfriendly feelings towards them.”

Dr. Bucknill's Letter.

There is another point in regard to the supervision of the insane, which has not been considered by the writer, but which may become of importance, as our communities grow in wealth, if indeed it is not such already. It is a matter which the customs of England made necessary in very early days; and, although we should not be likely to adopt precisely the same method to accomplish such an end, it has seemed best to give an account of what has been done there in the following interesting and important letter from Dr. Bucknill, for many years Lord Chancellor's Visitor, and still earlier a superintendent of large experience:—

“39 WIMPOLE STREET, W. LONDON, }
“November 28, 1876. }

“MY DEAR SIR:—You have set me by no means an easy task, but I will endeavor to give you at least a sketch of the function of the Lord Chancellor's Visitors of Lunatics.

“It seems quite correct to say that the charge and control of the Lord Chancellor over lunatics is derived from feudal custom, under which the Crown assumed, as part of its prerogative, the care and custody of those who from want of understanding were incapable of taking care of themselves. This royal prerogative existed before the statute of 17 Edward II., called *Prerogativa Regis*, which is declaratory only. [See Elmer's Practice in Lunacy.] And although Elmer thinks that the sovereign acted in this matter as *parens patriæ*, it seems more probable that this power was assumed as the head or chief of the military force. A lunatic vassal not being able to render that service upon which the tenure of his land depended, in consequence of his being *non compos mentis*, the sovereign assumed, for the time being, the direct control of his property, most property in those ages being in the form of landed possessions.

“I do not think that I need trouble you with any account of the manner in which the Crown deposes its authority over lunatics, under the sign manual, to the Lord Chancellor, assisted in later years by the Lords Justices of Appeal, nor with the somewhat nice and difficult question of the point where matters in lunacy cease to be under the royal prerogative and come under the ordinary jurisdiction of the Court of Chancery.

“The control and custody of lunatics by the Lord Chancellor under the sign manual, is now regulated by several Acts of Parliament, called the Lunacy Regulation Acts. The earliest of these is dated July 24, 1833; the second, August 15, 1853; and the third and last, August 7, 1862.

“The most important officials whose powers are created and defined under these Acts are the masters in lunacy, whose duty it is to preside, as judges under the great seal, at all inquiries as to the soundness or unsoundness of mind of any person alleged to be of unsound mind and incapable of taking care of himself and his affairs. This inquiry is called an inquisition, and takes place in consequence of an order to that effect of the Lord Chancellor, which order is the result of a petition from some person or persons interested, or of information given to the Lord Chancellor, that a certain person, being of unsound mind, has property which is not properly protected.

“In the initial stage, all these proceedings have reference to the care of the property, rather than to that of the person of the lunatic. After the person has been found lunatic by inquisition, the master has to ascertain what property he possesses, and who are interested in it as the heir-at-law and the next of kin. They have to devise a scheme for the proper care and expenditure of the property, and for the proper care and treatment of the lunatic, and for this purpose they nominate two very important officials in each case, who are

respectively called the Committee of the Person and the Committee of the Estate. As a general rule, the Committee of the Person is the next of kin or some one who has an interest in the continuance of the life of the lunatic, while the Committee of the Estate is the heir-at-law, who naturally has a strong interest in the protection of the property, and, as may be expected, these interests very frequently conflict.

“The Committee of the Estate receives the proceeds of the property, hands over to the Committee of the Person so much of it as he may be ordered to do by the court, for the maintenance of the lunatic, and accounts for the whole to the Master in Lunacy.

“The Committee of the Person has the charge and care of the lunatic and of his treatment. He ought to expend upon his care, treatment, comfort and pleasure the whole of the moneys he receives for that purpose. He enjoys a very wide liberty and choice as to the manner in which he discharges the duties he has undertaken, and he is exempted, in many important respects, from the operation of the lunacy laws as they apply to persons who are of unsound mind, but have not been so found by inquisition; for instance, he has the power of placing the lunatic in any asylum without medical certificates. It is the main function of the Lord Chancellor's Visitors to ascertain the manner in which the Committee of the Person discharges his duties and to report them to the Lord Chancellor.

“The appointment and powers of the Visitors were first enacted in 1833, 3 and 4 Guilielmi IV., under which, section second, two physicians and one barrister were appointed for the purpose of ‘*superintending, inspecting and reporting upon* the care and treatment of all persons found idiot, lunatic, or of unsound mind by inquisition.’

“The visits under this statute were only once a year, and the superintendence, therefore, could not be very stringent.

“Twenty years afterwards another statute, 16 and 17 Vic., cap. 70, further defined the duties of the Visitors, and constituted them into ‘a board for their mutual guidance and direction in matters connected with the visitors of lunatics,’ and at the same time subjecting them as to the times, rotation and manner of their visitations to the *general orders* of the Lord Chancellor, which general orders, often having been laid before Parliament and not having been objected to by Parliament, then acquired the force and validity of law.

“Such general orders were made and issued on the 12th of January, 1855, by Lord Cranworth, the then Lord Chancellor, with the advice and assistance of Lords Justices Knight, Bruce and Turner; and notwithstanding the important alterations made in

lunacy regulations by the statute of 1862, these general orders of 1855 still form a main part of the law under which the visitors must act.

“The second and third of these general orders are the most important, and are as follows :—

“ ‘ 2. That the medical visitors of lunatics do on each occasion of visiting any lunatic, inquire and examine whether such lunatic is maintained in a suitable and proper manner, having regard to the then existing amount of the allowance ordered to be paid, and the then existing scheme approved of for the maintenance of such lunatic; and also, whether having regard to the then fortune and income of such lunatic it appears expedient that any, and what, addition should be made to his comforts, or any, and what, alterations should be made in the scheme for or manner of his maintenance.

“ ‘ 3. That if the said visitors shall, on such inquiry and examination, consider that the lunatic is not maintained in such suitable and proper manner as is aforesaid; or that the allowance provided for his maintenance is not duly applied; or that any provision in the scheme for his maintenance, either for his personal comfort or enjoyment, or otherwise, is not duly observed; or that any addition to the comforts, or any alteration in the manner of the maintenance of the lunatic should be made, to which his then fortune or income is capable of providing, they shall forthwith make a special report, stating such their opinion, and the grounds thereof to the Board of Visitors.’

“The fourth order directs that the Board of Visitors shall consider the report made to them by the individual visitor, and, if they think fit, refer it to the masters, ‘or take such other steps therein as may appear to them to be expedient.’

“The fifth order directs that the masters may investigate any such report, and make such report to the Lord Chancellor as they ‘may deem proper.’

“In 1862, a new Act of Parliament was passed, under the old title of Lunacy Regulations, 25 and 26 Vic., cap. 86, by which the visitations to Chancery lunatics living in private houses were increased from once to four times a year, the duties of the visitors being left otherwise very much as they were fixed by the earlier statutes and defined by the general orders which I have quoted.

“These duties, as fixed by the statutes, by the general orders, and by the direction of the Board, may briefly be defined as follows: England and Wales are divided into three districts, each of which is taken by each visitor in rotation; that is to say, for two consecutive visits to patients living in private houses.

“Each patient living in a private house is visited once in each quarter of a year, each patient living in an asylum is visited once a

year. This distinction is made by the statute of 1862, no doubt, on the ground that all lunatics residing in asylums are also visited by the commissioners in lunacy and in the provinces by justices of the peace, acting, either as visitors of licensed houses or as visiting justices of county asylums, whereas lunatics residing in private houses are visited only by the Lord Chancellor's visitors.

"The visitors have to inquire and report upon these several heads: 1. The state of mind of the lunatic. 2. His bodily condition. 3. His care and treatment, having regard to the due provision of comforts ordered for him by the court and to the amount of his income.

"If everything is satisfactory on these heads, they have to report thereon to the Lord Chancellor direct; but if on the contrary, they have to make what is called a special report, which is made, in the first instance, to their board, by whom it is dealt with either; (1) by calling the committee before them, to whom the fault found is communicated, and by whom, in many instances, amendment is promised and carried out; (2) by referring the report to the masters, who have large powers of control over the committees, deputed to them by the Lord Chancellor; (3) by reporting directly to the Lord Chancellor himself.

"In the great majority of cases the special reports of the visitors have reference to some neglect of duty on the part of the Committee of the Person by which the lunatic suffers; and, in the event of the committee proving refractory to the reasonable demands of the visitors, the Lord Chancellor may, as a *dernier ressort*, dismiss him from his office. In a smaller number of cases the special report has reference to an inadequate allowance made from the estate for the maintenance of the lunatic, and in another class of cases the special reports have reference to the recovery of the lunatic, in which case the former lunatic has to present a petition to the court that his inquisition may be superseded. Such is the system which you ask me to explain,—not a very simple one I fear you will think,—but upon its merits or demerits I do not feel that I am in a position to offer an opinion.

"I am, my dear Doctor Folsom,

"Yours very sincerely,

"JOHN CHARLES BUCKNILL."

CERTAIN ASYLUM NEEDS.

Education in Hygiene.

It is a common opinion that purely mental exertion is the most common predisposing cause of disease of the mind,

especially when joined with any of the three "causes" most frequently assigned in the reports of our insane asylums; namely, heredity, intemperance, and ill-health. The first authorities, however, consider that such is not entirely the case; that emotional excitement, disappointed hopes, or some form of egoism are more frequently at fault, and that the best preventive of mental disease, even in those predisposed to it, is education, or wisely directed intellectual activity, leading to a knowledge of the proper ways of living.

Although essentially a disease of high civilization, and not prevalent largely where there is little competition for the prizes of life, or where the struggle for existence involves the exercise of muscles rather than of brains, insanity prevails most, other things being equal, where thought stagnates. Even Pinel speaks of its rarity among those professions giving exercise to the intellectual and not the emotional faculties.

"The more joints, the more rheumatism," was the apt criticism on one of those marvels of workmanship that lately came from the hands of one of our microscope makers. In like manner, as our civilization becomes more complex, as our capacities for enjoyment intensify, so is the keenness of our suffering sharpened, so do the requisites for moral, mental and physical health become more numerous; and, unless a sound education gives us a correspondingly greater knowledge of that wonderful mechanism, the human body, disease of all kinds must increase.

If, therefore, the mere healthy development of the brain in itself conduces to preserve its health, how doubly important that education becomes when it is made to teach general laws of nature, and the special course to be taken in each individual case to preserve bodily and mental health. But what is done in our high schools, our colleges, our medical schools, or even in our asylums, to accomplish such a desirable result? We must answer, almost absolutely nothing.

Even in our asylums, where the medical staff are busied with a multiplicity of routine duties, and have time for little else, the convalescents and sufferers from chronic illness not only do not get that information which many of them would gladly receive, and which would help them to maintain their

health to a sufficient degree to remain at home when discharged, but they are not even taught the evils of persisting in a diet which surely adds to their chances of a relapse, or in habits as regards exercise, clothing, ventilation, etc., which certainly do not promote health. As a natural consequence, it often follows that they go home, refuse advice, continue in their erroneous methods of living, follow a course whose logical result is a relapse or recurrent attack and return to the asylum with diminished chances of a permanent cure.

Of course, it is not meant to say that there are not many who will neglect all advice, others who are mentally incapable of sufficient persistent effort to follow wise counsel, and a certain number whose predisposition to disease is so great as to render them unable to bear the trials common to the lives of most people without breaking down; but experience justifies the statement that even with those who have had one attack of mental disease, a second may, in some cases, be warded off by wise methods of living.

Better Hospitals and Trained Nurses.

We recognize the fact that insanity is a disease of a purely material organ, and yet we go on building our hospitals for treating it essentially on the same plan as when they were simply regarded as prisons for confining persons dangerous to society; we do not provide a single ward* for the care of those who need to be removed from the boisterous noise, occupation, and amusement, which are the only salvation for others to prevent their relapsing into incurable insanity; and more important still, although we have many excellent attendants, of whose faithfulness and intelligent devotion to their work it is impossible to speak without some degree of enthusiasm, we lack some system of training them for their work.†

* This is considered of great importance elsewhere. We find the following criticism by the Commission in Lunacy on an English asylum in 1875: "In connection with matters relating to the treatment of the sick, we desire again to draw attention to the want of a ward set aside as a hospital, and furnished with proper furniture and appliances for the patients laboring under bodily disease."

† In many establishments in France, as early as 1837, the attendants were required to have undergone a system of training previous to their appointment; and attendants were trained for other asylums at the retreat in York, forty years ago. In Scotland, the commissioners keep records of all attendants who have been discharged from any asylum for any gross fault, so that they cannot be employed again elsewhere, in ignorance of that fact.

In many of our asylums, we have not a single educated nurse* who knows how to care for any severe illness confining patients to their beds.

This difficulty of getting trained nurses and attendants is one of serious moment. A dozen years ago it was nearly impossible, and the systematic and thorough education of them for their work began only since the Crimean war. Dr. Bell's "Directions for Attendants" is the earliest treatise which I have been able to find devoted to this important subject. Dr. Woodward published a similar one for the Worcester Asylum in the same year (1839) several years before Conolly's "Teachings for Attendants on Lunatics," and a dozen years before Dr. Kirkbride's and Dr. Curwen's. Florence Nightingale's "Notes on Nursing" came much later. It is not likely that these books have been heard of by many of our attendants, and it is possible to count on the fingers of one hand the places where this matter is arranged on a generally satisfactory basis.

In two of the large hospitals of England (the London and St. Bartholomew's) the nurses have only lately been relieved of the scrubbing. In our asylums we expect one person to be nurse, attendant, night-watch, companion to the patient, and wash the windows and scrub the back-stairs, all for a less sum than we pay to a second-rate cook.

Dr. Maudsley and Dr. J. Crichton Browne have lately set on foot a plan for female nurses in male wards in insane asylums, and it is said "the presence of women nurses in the male wards is found to be much more effective in restraining outbursts of violence, abusive language and offensive habits than the presence of male nurses."

At the Mt. Hope Asylum, near Baltimore, the patients, nearly three hundred in number, are managed entirely by the sisters of charity. Physicians make regular morning visits, but none are resident. In each male ward there is one male attendant, subordinate to the two sisters in charge of that ward. The sisters say, themselves, that they have no serious trouble even with the most violent patients, and that, indeed, excitement in the men is even more readily quieted by them than by the male attendant. When visited, without warning,

* In many European hospitals there are both nurses and attendants.

by the writer a few months ago, the wards were in excellent order, quiet, and without that untidiness which is usually found where men have sole charge.

There are some admirable features about the asylum, which are certainly not common in this country. Some of the rooms of the convalescents and quiet chronic cases have windows without guards, as is the case in the passage-ways, in the pleasant chapel, entries, and in the cheerful entertainment hall, where patients likely to harm themselves or others never go without having attendants close at hand, if at all; a prison-like appearance is thereby avoided, wherever it seems easy to do so. The sisters devote themselves so closely to their charge, that they consider high fences and "airing-courts" also unnecessary. We might well learn an important lesson from their work, which has been going on quietly for nearly half a century, since it was begun under the wise and thoughtful direction of the late Dr. Steuart.*

In providing for the chronic, incurable insane, separating them from society, which is strong, and from the actually ill, who are weak, the Willard Asylum has proved a success; but nothing satisfactory has yet been done by us for those of the curable who are depressed by their ordinary surroundings in our asylums, as at present managed. Classification does not accomplish the desired result, where one roof covers such a diversity of disease and of mental condition; but it would be a great error and injustice to make curability alone the basis of division; for many of the chronic insane maintain their intelligence and self-respect, often help and cheer the curable, and would suffer if placed with demented. Those who are so far demented as to have lost their human identity should manifestly be kept away from the rest, just as much as from children or any others likely to be unfavorably influenced by association with them. With the comparatively small number whose condition is for a while a matter of some question, it would not be difficult to give them the benefit of the doubt.

* See page 343. The Mount Hope Hospital was built by the sisterhood who were originally in charge of the Maryland Hospital under Dr. Steuart.

MEDICAL EDUCATION.

The matter of medical education is with us, at the present time, a most pressing one. Its importance has long been recognized. Governor Adair in his message to the General Assembly of Kentucky, in 1821, urged as one reason for the establishment of a state insane asylum, that it "would prove highly beneficial to the medical school, which would, in time, repay the obligation by useful discoveries in the treatment of mental maladies"; a prophecy which it is needless to say has not been fulfilled.

Thirty years later, Dr. Pliny Earle, after his return from Europe, urged strongly the necessity of establishing professorships of mental disease, and finally that has been done in a few of our leading medical schools; although, in one of the best, the lectures were first delivered in private parlors, as the faculty did not deem them of sufficient importance to be given at the college.

In none of our medical schools, however, except in New York, is disease of the mind taught clinically by observation, although there is not one of importance in Europe where it is not so taught. As has been well said by Dr. Gray of Utica, "the evils of this lack of attention to the pathology of insanity, and want of knowledge of the true character of the disease, are much greater than the public are aware of. If the result was only an indifference to the whole subject by medical men, it would be bad enough, but it is far worse. It is the application of a false theory, which not only deprives the sufferer of proper treatment, which he has the right to claim, but subjects him to wrong and injurious treatment, and especially to neglect of remedies in the beginning when the disease is in its curable stage."

Formal lectures on such a subject are of just as much practical use as in any other disease, and of no more. Without the hospitals of Paris, Vienna and Berlin, and the instruction at the bedside and in the dispensary all over the civilized world, Louis, Laennec, Oppolzer, Skoda and Traube might almost as well not have lived; their brilliant discoveries in the detection of the different forms of thoracic disease would have scarcely helped the world at large, and we should

have gone on treating the cough which needs rest in bed in the same way with that which warns us to drive our patients out into the open air, thereby sacrificing many a life which we now save.

The vague nomenclature, the supposed difficulty of diagnosis and treatment, the assumed ground that insanity can be treated only by persons peculiarly gifted, and in nearly all of its forms in buildings specifically constructed, has conduced to this omission on the part of our universities. We have learned that nature makes no leaps, and that there is no positive line of demarcation between sanity and insanity; that about one-half of the recent cases get well, of whom a little less than half remain so; that hallucinations of sight and hearing may be the genius of inspiration in Joan of Arc and a conclusive evidence of insanity in somebody else; that Julius Cæsar, Mahomet and Napoleon suffered from a mental disease, by virtue of which persons are held not accountable for murder in modern courts; that a false belief is not necessarily a delusion; that Martin Luther was not insane; that the Agrippinas, Neros, Caligulas and Tiberiuses of history were probably only the monstrosities which occasionally appear in modern times; that insanity was increased by the Crusades, the Reformation, the American and French revolutions, the Retreat from Moscow, the Commune, the religious revival in Edinburgh, and diminished in the manufacturing districts of England when the "hard times" compelled the laborers to drink less gin.

But how does all this interesting information help us, when the ink on our diplomas is scarcely dry, and we are called upon to sign a paper* which will send a woman to an insane

* In New York State there is a restriction, whereby only those physicians thought to be qualified to do so, are allowed to sign certificates admitting persons to insane asylums. The law on the subject is as follows:—

Section 1, 2, 3, of Chapter 446 of the Laws of 1874.

SECTION 1. No person shall be committed to or confined as a patient in any asylum, public or private, or in any institution, home or retreat for the care and treatment of the insane, except upon the certificate of two physicians, under oath, setting forth the insanity of such person. But no person shall be held in confinement in any such asylum for more than five days, unless within that time such certificate be approved by a judge or justice of a court of record of the county or district in which the alleged lunatic resides, and said judge or justice may institute inquiry and take proofs as to any alleged lunacy, before approving or disapproving of such certificate

asylum for life, or deprive a man of the power to make his will, when we cannot for our lives tell the difference between *folie circulaire* and general paralysis, when we cannot recognize many of the simplest forms of mental disease in their early stages, and when we do not know whether the best treatment consists in sending our patients to the inactivity of an asylum or for a tramp among the hills, or whether he can as well or better be cared for at home?—an uncertainty which deprives many of the benefit of early treatment. It is certainly as rational to treat common cold and consumption alike because they affect the same organ, as to say that the manifold forms of mental disease should all be subjected to the same general rules.

Insanity, in the reports of our asylums for the insane, is the disease of which so many recover, so many do not, and so many die; but it would be fully as rational to say the same of all patients entering our general hospitals with "cough" and "pain in the chest"; for insanity is really only a symptom of disease, or perhaps a combination of symptoms; and the disease underlying it is often incurable from its very nature, and often readily yielding to treatment. The different forms often require as different treatment as brain fever and pulmonary consumption.

This confusion of names and of things, has undoubtedly had a seriously prejudicial effect on medical education, and is in a large degree the direct result of this very want of adequate instruction in our medical schools.

It cannot be denied that the sciences are each year claiming a greater part of the student's time, already too short for the

and said judge or justice may, in his discretion, call a jury in each case to determine the question of lunacy.

§ 2. It shall not be lawful for any physician to certify to the insanity of any person for the purpose of securing his commitment to an asylum, unless said physician be of reputable character, a graduate of some incorporated medical college, a permanent resident of the State, and shall have been in the actual practice of his profession for at least three years, and such qualifications shall be certified to by a judge of any court of record. No certificate of insanity shall be made except after a personal examination of the party alleged to be insane, and according to forms prescribed by the State Commissioner in Lunacy, and every such certificate shall bear date of not more than ten days prior to such commitment.

§ 3. It shall not be lawful for any physician to certify to the insanity of any person for the purpose of committing him to an asylum of which the said physician is either the superintendent, proprietor, an officer, or a regular professional attendant therein.

work he must do ; but, in adding to our requirements for graduation, we have only begun to drop the lumber which medicine, as a dogma, had to carry. Of what importance is it, for instance, to the busy physician, to know that the morphine which he injects in his patient's arm, is from the *papaver somniferum*, and not from some other *papaver*, and to be able to give all the complex processes by which it is prepared for use? What cares he from which one of the *scrophulariaceæ* comes the drop which quiets the too rapid pulsation of the heart? These things are all very well—the expert must know them ; but are they of sufficient importance to exclude a practical study of vitally important problems which meet every physician face to face in every year of his practice?

If we have time for only the necessary and fundamental branches, why not recognize the fact that the physician simply begins his education in the medical school and leave out many of the details which only a specialist is required to know, to be filled in by reading afterwards? With four thousand people in our State suffering from mental disease, and with the superintendent of every insane asylum in the country complaining that curable insanity is almost universally neglected in its early and curable stage, are we wise to exclude its careful study from our list, in order to have more time to investigate the action of digitalis and belladonna on rabbits and guinea pigs, or to learn difficult surgical operations which many will not see and only a few experts will ever perform?

"Taking the word hygiene in the largest sense," said the late Dr. Parkes, "it signifies rules for perfect culture of mind and body." In this maxim, and in its observance, we must look for our greatest help in convincing the community that insanity, like other diseases, is to a great degree preventable, and that to cure or to prevent it, we must first study it.

It is gratifying to find that such a serious defect in our medical education is attracting the attention of thoughtful people. In a recent report by one of our most distinguished sanitarians, we find these words: "A third branch of medicine, which is not taught in our schools, is the diagnosis, treatment and jurisprudence of insanity. I do not know if it will be possible to deal with this subject in this university, but I would keep this urgent want in mind, and the possibility

of making connections with some public or private establishments devoted to the care of the insane, which can supply the necessary facilities and receive more than a corresponding benefit." *

No truer word has been spoken than that "Insanity is part of the price that we are paying for the imperfection of our civilization and the incompleteness of our education." †

SUMMARY.

If our century's work seem to any to offer not enough to say in favor of our past, when we have been spending millions in the construction of asylums, without diminishing the amount of insanity or increasing our cure-rate, the present offers many signs of encouragement. We have made mistakes, it is true, and we are still in doubt as to many important points; but earnest people are at work over the whole civilized world, and more and more certainty is reached every year.

That we have started from as small beginnings, and have made no more progress in other branches than in insanity, may readily be seen by consulting John Howard's account of prisons, hospitals, etc., in Europe, published in 1789, and an excellent treatise on "A Century of Nursing," by a member of the hospital committee of the State Charities Aid Association of New York, issued during the past year.

If we go beyond this century, we shall see that there have been in modern times four great epochs in the history of the treatment of insanity.

(1.) The abolition of the theory of possession by evil spirits—a work of humanity, in which St. Vincent de Paul was the great mover, two centuries and a half ago.

(2.) Pinel's reform—also essentially humanitarian.

(3.) The adoption of the idea of the curability of insanity; the establishment of the *heil-anstalten* in Germany; Esquirol's visit to Gheel and his theories of asylum construction; the laws in England compelling the several counties to

* Johns Hopkins Hospital, Reports and Papers relating to Construction and Organization, No. I. By John S. Billings, Asst. Surg. U. S. A.

† Relation of Education to Insanity. By Edward Jarvis, M. D., in the Report of the United States Commissioners of Education for 1871.

provide for their pauper insane, and establishing a lunacy commission; Rush, Wyman, Bell and Kirkbride in asylum construction and management; Ray and others in the jurisprudence of insanity; the reduction of mechanical restraint in the United States forty years ago to a point below that in vogue elsewhere; and finally, the abolition of mechanical restraint begun by Hill and made a principle of treatment by Conolly. This may be called the practical movement, arising in England, France, and later in Germany, for a while reaching its highest point in the United States, now best in England and Scotland.

(4.) The general acceptance of the somatic and rejection of the psychic theory of insanity, by establishing psychology on the basis of physiology and pathology—a scientific movement anticipated by John Hunter, begun by Bichat and Esquirol, carried out by Griesinger and Virchow.

Humanity is now the basis of treatment everywhere, nowhere more laboriously and studiously sought for than in the best asylums of our own country.

The work of the future, the *rational* movement, will be for each nation to contribute its best, and for all to unite humanity, science and art in solving problems now satisfactorily met by none.

The history of mental disease shows a steadily progressive development of rational views in its treatment. So long as divine inspiration was thought to be its cause, the insane were treated as seers and prophets; and, as such, their influence on society has been a potent one. Under the later theory of the Middle Ages, they were burned or hanged by the courts, and whipped by their custodians, the monks. After St. Vincent de Paul, violence and force in their treatment gradually gave way to deliberate imposture. For a while, the satirist might have said that their care under the doctors consisted in showing that what was good for a sane man was bad for one insane; and it used to be taught, even from the professors' chairs, that patients were benefited by continual morbid surroundings, while the doctors must make a special exertion under the same circumstances not to become insane themselves; that asylums for the chronic insane would be fatal to the reason

of the curable cases which would be inevitably placed with them, but that it did no harm to subject acute cases to their daily influence in large asylums, and that the insane have a peculiar exemption from diseases and influences ordinarily affecting well people.

It was a long time before we made our practice at all correspond with our knowledge that insanity is a disease, and we have by no means done it fully yet; but now physicians know that they must gain the respect and confidence of their insane, just as they do with their other patients; and Dr. Farr, after thirty-eight years' experience in the science, which he made, of sanitary statistics, says, in his thirty-sixth annual report, "In fact, as far as is known, a lunatic remains as subject to zymotic, constitutional and various local diseases as sane people."*

In the majority of cases, a well arranged asylum is a better place for an insane person than his home; but the asylums might be made much better than they are, if we used a small part of the money now expended to gain a questionable architectural magnificence in providing more attendants and in improving our facilities for medical treatment.

To get the benefit of such improved asylums in properly selected cases, our general practitioners must understand mental diseases, as the majority of patients come under their exclusive observation in the early and more curable stages. When our medical schools have given them this knowledge, may we not fairly expect an improvement in the results of our treatment, corresponding with what has taken place in the early stages of pulmonary consumption and Bright's disease, especially when the superintendents, who are now overburdened with routine work, have more time to devote to their strictly medical duties?

It cannot be said that this is a subject which interests comparatively few persons. Such is the general impression, without doubt, and most people look upon insanity as something "hereditary," to which not many are liable. On this point, our highest authority said to the trustees of a new asylum:† "From the sad disorder which is to be treated within these walls, no one has any privilege of exemption. No accident

* Registrar-General's Report for 1873, page 221.

† Address at Danville, by Isaac Ray, M. D., 1869.

of fortune or birth, no measure of strength, no exercise of prudence may be able to save you from the fate of others once as little likely to meet it as you. Or, if you escape personally, the stroke may fall on child, parent, or neighbor with far more sorrow than if it fell on yourself. You, therefore, are deeply interested in having it perform its allotted service successfully, and are bound, as far as in you lies, to promote this end,"—an opinion fully sustained by Dr. Kirkbride, who says,* "Insanity is a disorder of the brain, to which, under certain contingencies, every one is liable." Hagen, too, after exhaustive researches extending over a period of twenty-five years,† has concluded that the influence of heredity, although considerable, is still much less than has usually been supposed. The very large number who marry wisely, and do not transmit their infirmity to their offspring, do not usually appear in our statistical tables.

Some of our most experienced and best-informed alienists consider the manifold diseases of the mind no more likely to be transmitted to offspring than Bright's disease and pulmonary consumption. The evidence is strong, also, that they may be as readily eliminated from families by wise marriages and judicious modes of living. In either disease, of course, there are cases where any marriage must be looked upon as unwise; but they are not so universal as has been sometimes supposed, and the transmission to descendants of what has been sometimes called the insane temperament has given to the world many men and women of genius, whom we could ill have spared.

Even as late as the time of the Ptolemies, the plague was unknown in Egypt.‡ One hundred years ago, it was thought a necessary part of modern civilization, and now, under a still higher civilization, the area over which it may be feared is narrowing from year to year. A similar result may be fairly expected with regard to disease of the mind.

* Report for 1876.

† Statistische Untersuchungen über Geisteskrankheiten. Erlangen, 1876.

‡ Ueber den Hungertyphus und einige verwandte Krankheitsformen, von Rudolph Virchow. Berlin, 1868, p. 53.

HEALTH OF TOWNS.

DIPHTHERIA IN LYNN,

BY J. G. PINKHAM, M. D., CORRESPONDENT OF THE BOARD IN LYNN.

DIPHTHERIA IN SALEM,

BY A. H. JOHNSON, M. D., CORRESPONDENT OF THE BOARD IN SALEM.

DIPHTHERIA IN LOWELL,

BY F. NICKERSON M. D., CORRESPONDENT OF THE BOARD IN LOWELL.

REPLIES FROM CORRESPONDENTS:

INCLUDING NOTES OF AN EPIDEMIC OF TYPHOID FEVER IN
SOUTH DENNIS,

BY DR. C. M. HULBERT, MED. CORR.

HEALTH OF TOWNS.

DIPHTHERIA IN LYNN IN 1876.

In investigating the nature and causes of the epidemic of diphtheria which has just visited Lynn with such fatal violence, regard has been had primarily to three special points, viz.: 1. The natural conditions under which the disease has prevailed. 2. The artificial conditions under which it has prevailed. 3. Its contagiousness.

It was thought that more would be gained by limiting the inquiry in the main to these questions, which seem to lie at the foundation of all public measures of prophylaxis, than by attempting to go over the whole range of interesting subjects connected with a disease so wide-spread and fatal as to demand the most thorough scrutiny of all facts in any way bearing upon it.

The aim has been, in making up this report, to present only carefully determined facts, and present them in such a way that the reader may be able to form his own opinions as to the correctness of the conclusions derived from them.

The sources depended on for information have been: 1. Accounts furnished by physicians. 2. The public record of deaths. 3. A personal inspection of infected premises and localities.

In this way knowledge has been obtained of 518 cases occurring during the year. Complete reports were made by sixteen physicians of the place. The ratio of fatal cases to the whole number for these complete reports was one to 4.9. Allowing the same to have obtained in the practice of the physicians who made no report, a deficiency of 96 cases is estimated. This brings the whole number up to 614, which cannot be far out of the way. The estimated population of Lynn for 1876 is 33,550.

The work of personal inspection was performed mainly by Dr. S. W. Clark, to whose faithful and efficient assistance your correspondent is much indebted. Acknowledgments are due also to the physicians who have so cheerfully furnished full information in

regard to their own cases. Without their generous aid this report would have been impossible.

The table which follows contains an account of 104 cases, not selected, but taken at random, and believed to be a fair average of the whole. Of the 104 cases, 27 were fatal, or one to every 3.8 cases. This is a larger ratio of fatality than the average of the year. The explanation of this fact is found in the circumstance that the data for the table were collected early in the summer, and the cases investigated were, therefore, mainly those occurring in the season of high mortality. When the dates of the cases in the table are taken into consideration in connection with the monthly percentages of fatality given in the chart, it will be seen that the epidemic is not misrepresented in this particular.

The principal facts which we have attempted in this way to set forth have been those pertaining to the natural character of the localities in which the disease prevailed, and the hygienic condition of infected premises and their surroundings with respect to house drainage, the water-supply, privies, refuse-heaps, barns, piggeries, etc. In order to make the data as reliable as possible, hearsay evidence has been rejected in regard to all points which could be determined by a personal examination.

In a large number of cases time would not allow the investigation necessary to enable us to tabulate them. This led to the construction of the map, which is believed to show the distribution of all the fatal, and at least four-fifths of the non-fatal cases occurring during the year. Owing to the relatively large size of the indicating marks, it was not possible to show by their means the exact spot of occurrence of every case. The object has been attained by indicating in a general way the locality. The fatal cases are shown by a spot, the non-fatal by a cross. Marsh lands are represented by the deep green tinting, less degrees of dampness of soil by the lighter shades. Mr. I. K. Harris, who made the map, having been for many years city engineer and familiar with all portions of the town, was able to supply the very valuable knowledge needed for this part of the work.

The larger map given in connection with the report on the sanitary condition of Lynn, can be referred to for sewerage, height of land above the sea level, and other facts.

Under what Natural Condition has Diphtheria prevailed in Lynn?

Upwards of 80 per cent. of the cases given in the table were in the valleys of brooks, or near marshes or bodies of water, where the soil is usually more or less damp. They were nearly all in the



outskirts of the town, where no means of artificial drainage have been adopted. The same statement, in a somewhat modified form, applies to the larger number of cases represented on the map. At the first glance it might appear that in the eastern part of the town the disease was more prevalent at a distance from marshes and brooks; but a careful study of the subject, taking into consideration the density of the population, proves that this is not the case. In that large tract lying north of Lewis Street, east of the line of Chatham and New Chatham streets, and south of Western Avenue, there is a population of 1,858. The number of cases ascertained as occurring here during the year was 100, or about one to every 19 of the inhabitants. The disease may be said to have reached its maximum prevalence in this region, for nowhere else was the ratio of cases to the population so large. In the city the ratio of ascertained cases is one to every 65 of the inhabitants; of ascertained and estimated cases, one to every 54. The section above mentioned is wholly undrained, and contains, as shown by the map, much damp land. The inhabited portion of it is nearly all in the valley of Stacey's Brook and branches. To the westward of this is another more populous tract which appears by the map to have been severely visited. Regarding it as bounded on the east by Chatham Street, on the south by Lewis and Broad streets, on the west by a line drawn from the junction of Broad and Exchange streets to High Rock Street, in such a way as to leave Hutchinson's Court on the right, and on the north by a line drawn from this point along the course of Adams Street to Chestnut, thence to the junction of Collins and Chatham streets, a liberal estimate of the population would be 6,236. The number of cases of diphtheria occurring during the year within these limits was 139, or about one to every 45 of the inhabitants, less than half that of the section to the east. This tract contains Silver Lake, Goldfish Pond, and some spots along Essex Street, damp from the drainage of the hills; but the greater part of it may be described as high and dry. It is, however, mostly undrained.

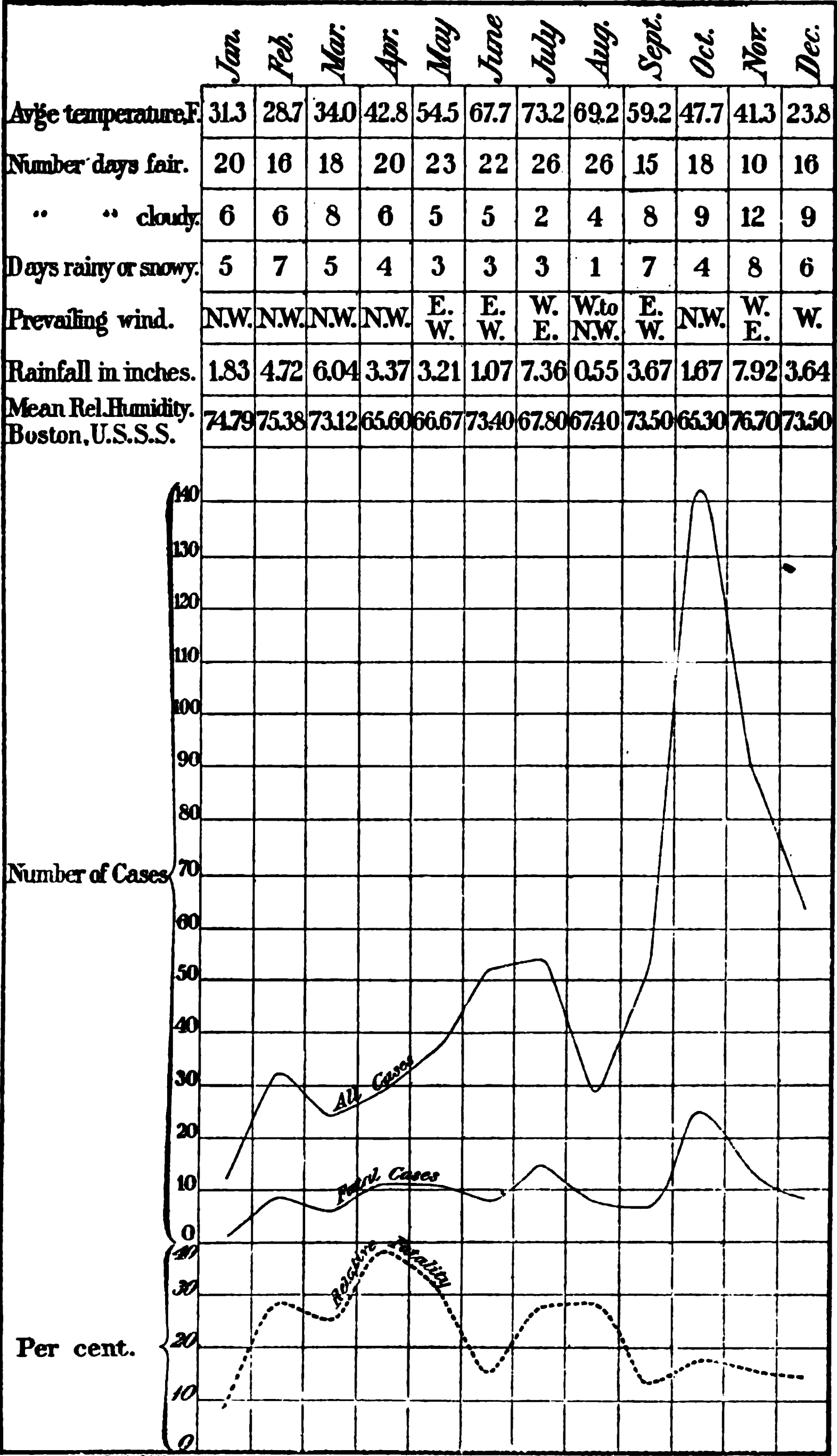
In respect to the western part of the town, no calculation is needed to exhibit the preference of the disease for the vicinity of marshes and brooks. One needs but compare, on the map, that strip of land lying between Summer Street, Western Avenue, and the marsh, with that lying above, between Summer and North Common streets, to be convinced of the truth of these statements.

The height of the land above the level of the sea appears to have no influence on the disease, except so far as it determines the condition of the soil. In several of the sections which were severely visited there is a clay subsoil, and the water-table is high.

The chart which follows shows the monthly prevalence of the disease throughout the year, together with the average temperature, the number of fair, cloudy, and stormy days, the prevailing winds, the rainfall, and the mean relative humidity of the air. When one initial letter is written above another, as $\frac{E}{W}$, it signifies that the two winds are about equally prevalent, the one above being slightly in excess. The date of occurrence of 509 of the cases was correctly determined. The remaining 105 were distributed among the months in proportion to the number previously ascribed to each. This was done in order to preserve the proper ratio between the fatal cases and the whole number. Its effect is simply to raise the upper line of the chart, and lessen in proportion the percentages of fatality given below. The fatal cases were all determined accurately from the public record of deaths.

In this chart October is seen to tower above all the other months, like a mountain-peak. It is something marvellous, the rapidity with which the disease, from its temporary decline in August, increased through September up to its maximum in October, and then fell off again. Over 23 per cent. of all the cases occurred in October. The minimum prevalence was in January, which had less than two per cent. This was almost in the very beginning of the epidemic, and a comparison of the two months would be hardly just. January may be described, however, as a mild and pleasant month. It would not be unfair to compare October with November, which stands next to it in point of prevalence, but is yet far below.

The former was several degrees colder than usual, had much pleasant weather, prevailing north-west winds, a low rainfall and dry air; the latter was warmer than the average, had little pleasant weather, much east wind, a very large rainfall, and damp air. It was, in fact, an extremely wet, foggy, and disagreeable month. Yet during this time the disease declined very rapidly. It would not do, perhaps, to draw from this the conclusion that agreeable weather favors and disagreeable opposes the spread of diphtheria; but it is safe to say that the reverse of this proposition does not hold true. April, which gives us the maximum of fatality, was a pleasant month, with prevailing north-west winds, average rainfall, and dry air. September, which gives us the minimum of fatality (excepting January, which we exclude for the reason given above), was characterized by an average temperature, much unpleasant, easterly weather, an average rainfall, and damp air. The other months present very variable conditions, not always bearing the same relation as in the instances cited above, to the degrees of prevalence and fatality of the disease.



In the table given below, the seasons are compared :—

SEASON.	No. of Cases.	Ratio of Fatality.
Spring,	89	1 to 3.2
Summer,	135	1 to 4.3
Autumn,	283	1 to 6.1
Winter,	107	1 to 5.6

Spring is here shown to have had the least number of cases and the greatest relative fatality ; autumn the greatest number of cases and the least relative fatality. Winter and summer are intermediate in both these respects ; but the latter has a greater prevalence and ratio of fatality than the former.

Under what Artificial Conditions has Diphtheria prevailed in Lynn?

In answer to this question, it is necessary to state that the disease has not infrequently been observed under the most favorable hygienic circumstances ; but it requires only a cursory examination of the table to show that an overwhelming preponderance of cases occurred in connection with defective sanitary conditions. The long list of offensive privies, cesspools, sink-spouts discharging on the ground, hog-pens, etc., is in itself an argument admitting no answer in favor of the proposition that the spread of diphtheria is in some way promoted by the presence of filth. In comparatively few of the cases given in the table were the appointments and surroundings of the dwellings in all respects such as are considered favorable to health.

It is but just to state that many of the premises on which these things were observed were apparently clean and well kept, the owners not being aware that any defects existed until they were pointed out. In some instances only a close examination revealed them. An illustration of this may be seen in the case of family number 44. The house was well ordered, and the first impression was that everything was as it should be. But a careful search showed an overflowing cesspool under a bedroom window, not very noticeable, but sufficient at times to fill the room with an offensive odor. Three persons of the four constituting the family had diphtheria in a severe form. Two of these slept in the bedroom above mentioned, and the other in one adjoining. This will doubtless seem to many minds a trivial circumstance ; but it should be remembered that in the search for undiscovered truth, it does not always do to neglect trifles. If the doctrine of a contagium vivum, which is now coming into prominence, be accepted, it is easy to see that the filthy sink-hole might furnish the very conditions necessary

for the development of the bacterium which causes the disease, and the conveyance of its germs into the dwelling.

In the eastern section of the city, where the disease was very prevalent, the night-soil deposits, which, during the hot months sent forth such offensive effluvia, may have had some influence. Nearly one-half of all the cases which occurred in July were within the range of the emanations from these deposits, a portion of which were entirely uncovered and exposed to the sun and winds.

But not only has diphtheria been apparently favored in its spread by insanitary conditions, but under them the relative mortality has been much greater. Only four or five of the 27 fatal cases of the table were on premises that presented no defects either in themselves or their immediate surrounding. It is not hard, also, to trace a similar relation between insanitary conditions and the severity of non-fatal cases.

In the Waterhill District (see large map) there were, as ascertained, 37 cases in all, of which 20 were fatal—upwards of fifty-four per cent., or one to every one and eight-tenths cases. In the Ocean District, on the contrary, there were sixteen cases and two deaths—twelve and one-half per cent., or one in every eight. The difference here is marked, and can hardly be ascribed to any other cause than the well-known differences in the hygienic conditions of the two districts. If we allow to each district its proportionate share of estimated cases, the conclusion arrived at is essentially the same. The maximum of fatality appears to have been attained wherever dampness of soil, or subsoil, was coincident with faulty artificial conditions.

No instance has been reported in which the disease was thought to have originated in contaminated well-water.

Is Diphtheria Contagious?

The answer given by our physicians, almost without exception, to this question is yes! Certainly it has manifested during the present epidemic all the prominent characteristics of a contagious disease; for—

1. It has spread slowly from person to person, from family to family, from neighborhood to neighborhood.

2. Numerous instances have been observed in which individuals after a known exposure have been attacked.

3. There has been a well-marked though somewhat variable period of incubation.

4. As in the case of diseases universally regarded as contagious, there have been peculiar sequelæ.

Observe the grouping of spots upon the map. Isolated cases have occurred no more frequently than during epidemics of scarlatina and

other eruptive fevers. The rule has been, that when diphtheria entered a family, other cases followed the first, after an interval of time. Those brought into the closest relation with the sick person were the most liable to the attack. In the majority of such cases attended by your correspondent, mothers of very sick children themselves acquired the disease. When the father assisted in the nursing, he also in many instances was attacked,—less frequently when his duties kept him much away from home.

The following relation illustrates the manner in which the disease spread: A little girl was taken with sore throat while attending school. Not being very ill, no physician was called, and the disease was not recognized as diphtheria. While sick, she played with a baby of nineteen months, of whom she was fond, and a little girl of four, belonging to a different family in the same house. In less than a week the baby was taken with unmistakable diphtheria. The membrane invaded the nostrils, and death ensued on the fifth day. The little girl of four was taken in two days after the baby, but had the disease mildly. The mother and father were both attacked very soon after the baby's death. In the case of the mother, the membrane invaded the larynx and caused much difficulty of breathing, but recovery followed, as also in case of the father. Mrs. A., who visited the family during the baby's illness, was attacked with diphtheria about one week afterwards. Thus we see that the disease was carried from school to family No. 1, thence to family No. 2 in the same house, thence to an outside family. Many accounts similar to the above might be given.

The conclusions at which we have arrived in respect to the points studied may be briefly summarized as follows:—

1. Diphtheria has been more prevalent near marsh lands, in the valleys of brooks, and near bodies of water where the soil and sub-soil are naturally damp, than at a distance from such localities.

2. It has been most prevalent and least fatal in autumn, least prevalent and most fatal in spring; but there appears to have been no constant relation between the character of the weather and either the prevalence or fatality of the disease.

3. Other things being equal, it has been more prevalent and relatively more fatal where air and soil have been polluted by house-drainage, overflowing privies, decaying garbage, etc., than in places not subject to these conditions.

4. It has presented in an eminent degree the characteristics of a contagious disease.

5. Owing probably to its contagious nature, it has occurred on all kinds of soil, at all seasons of the year, under every variety of hygienic conditions.



DIPHThERIA IN SALEM IN 1876.

Diphtheria has been the most prominent disease in Salem during the past year, and has prevailed to an alarming degree.

I have obtained reports of 534 cases, which may be tabulated as follows :—

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
No. of cases,	18	20	24	13	21	22	24	36	37	58	126	135	534
Fatal, . .	1	1	3	0	4	1	6	9	4	7	9	19	64

Thus it appears that the percentage of mortality from this epidemic, for the whole year, was 12, that the greatest fatality occurred during the months of July and August, when it reached 25 per cent., that the epidemic gathered strength from July onward, and that 319, or more than three-fifths of the cases, occurred during October, November, and December.

The distribution of these cases, in the different wards of the city, has been as follows :—

Ward 1,	.	.	.	.	.	.	.	.	.	.	142 cases.
2,	.	.	.	.	.	.	.	.	.	.	67 "
3,	.	.	.	.	.	.	.	.	.	.	66 "
4,	.	.	.	.	.	.	.	.	.	.	94 "
5,	.	.	.	.	.	.	.	.	.	.	132 "
6,	.	.	.	.	.	.	.	.	.	.	33 "
											534 cases.

Whence it appears that, while all parts of the city have been visited by the disease, there are certain sections in which it has been especially prevalent,—a fact which is illustrated by the map (p. 447) on which the shaded portions represent the localities where diphtheria prevailed.

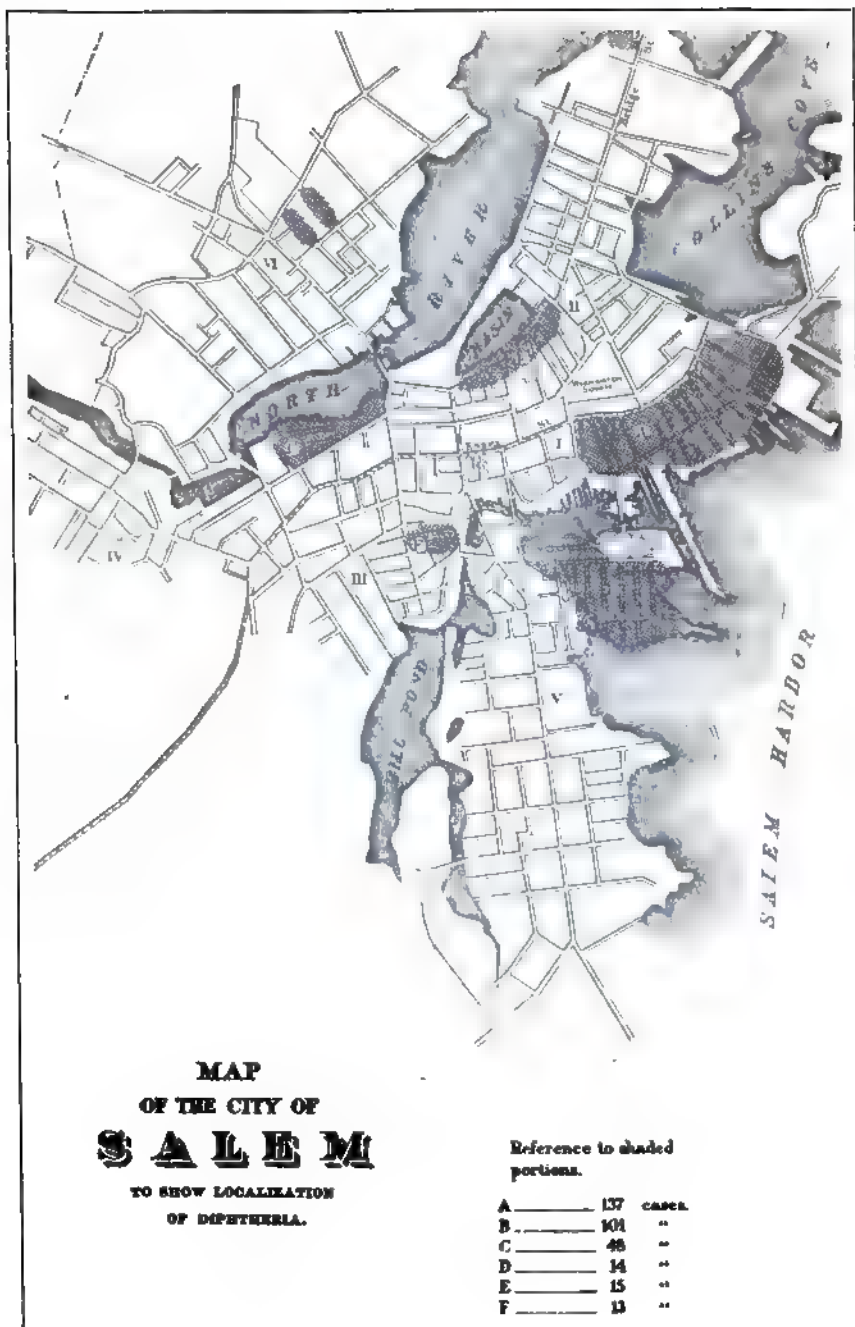
It is to be noticed that more than one-half the whole number of cases occurred in Wards 1 and 5. The population of the different wards is as follows :—

	Males.	Females.	Total.
Ward 1,	2,010	2,289	4,299
2,	1,924	2,482	4,406
3,	1,515	1,998	3,513
4,	2,022	2,468	4,490
5,	2,708	3,160	5,868
6,	1,629	1,753	3,382
Total,	11,808	14,150	25,958

Ward 1 is, therefore, the *fourth* for number of population, while it presents the largest number of cases of diphtheria. This ward occupies the south side of the narrow peninsula which forms the northern boundary of Salem Harbor, together with Salem Neck. This neck is, for the most part, an open territory with but few houses, and is used chiefly as a summer resort. For seven months in the year, its population amounts to a few scattered families and the Plummer Farm School. None of the cases reported occurred upon the Neck. Excluding, therefore, this portion of the ward, the territory it covers is comparatively small. If we strike out a little more than one-third of the remainder of the ward, namely, the portion lying west of Union Street, in which only five cases occurred, we have a very limited section in which 137 cases of diphtheria occurred. By far the larger portion of the families in this section belong to the poorer classes, who are forced to occupy small, sometimes crowded, tenements, and who, with insufficient or unwisely selected nourishment, undergo toil and exposure. But, in addition to the necessary accompaniments of poverty, many things are allowed to exist which tend to aggravate the dangers which arise when an epidemic approaches.

Only a small portion of the territory is drained. With the exception of the lower end of Essex Street, no public sewer exists east of Daniels Street. Refuse-water and slops are discharged into cesspools dug in the yards of houses, and then allowed to find their way through the soil; or, in many instances, they are thrown upon the surface of the yards, together with other refuse material. Many of the privies are mere superficial excavations in the soil, which soon become filled and noisome, and, in some instances, swine are kept to add their bountiful preparations to welcome disease.

Ward 5 includes all of South Salem. It embraces much unoccupied land, and the greater part of its territory is high and favorably situated. The northern fourth of the ward includes a low



peninsula, which is separated from the centre of the city by an estuary, and extends into the harbor. In this small district occurred 101 out of the 132 cases in the whole ward. This section has a large population of operatives in the Naumkeag Cotton Mills and laborers, many of whom are but poorly provided with the comforts, not to say necessities, of life. It is often the case that a family, with many children, occupies a tenement consisting of two or three rooms. That portion of this district which lies south of the Naumkeag Mills, for the most part, lies so low that the drainage is very imperfect. The land was not properly graded before the houses were built and the street accepted by the city. Hence, when the city, two years ago, laid a sewer through Congress Street, the sea-water, at high tide, flowed back through the sewer into the cellars. Whereupon the occupants ungratefully brought an action against the city for damages. A compromise was effected, and the difficulty guarded against, so far as the nature of the case permitted. I mention this circumstance to show the importance of a statute which shall forbid the erection, within city limits, of any dwelling-house whose foundation is not raised a proper distance above tide-water; the proper distance for each locality to be determined by the city engineer. In the neighborhood of which we are speaking, the occupants of many of the houses find it most convenient to throw their slops on to the surface of the yards, and do so, and often mingle with them much animal and vegetable refuse. At the foot of Prince and Pingree streets there is still the basin of water in whose neighborhood I reported nineteen cases of typhoid fever in the year 1874.

The ward in which the next largest number of cases of diphtheria has occurred is Ward 4, from which 94 cases are reported. This is an extensive district, and includes all north of Essex Street (excepting North Salem) from Washington Street to the boundary of Peabody, and all west of the Turnpike. Between North and Carpenter streets, or, in other words, in less than one-fifth of the more thickly inhabited portion of the ward, 48, or more than one-half, of the cases reported from this ward occurred. In the centre of this section are River and Lynn streets. River Street is on the right bank of the North River, and is high at its eastern, low at its western end. Lynn Street meets it at right angles near its lower end. Both streets are quite short. Both are without sewers. The houses on the southern, or upper, side of River Street are drained into cesspools or sink-holes. From the houses on the lower side the sewer-water runs over the surface of the ground, down the river-bank to the flats. At the lower end of the street, swine are kept. Near the upper end, a sewer which takes the sewage of a portion of

Essex Street and Beckford Street, empties into the sluggish channel of North River, the condition of whose banks is fully described in the report of the State Board of Health for the year 1874-75. On these two short streets 17 cases occurred.

Ward 2 presents the next largest number of cases; namely, 67. Of these, 48, or more than two-thirds, occurred upon Bridge Street and the short streets which lead from it on either side to the flats of North River and Collins Cove. Upon Hubon Street,—which is quite short, occupies low, damp ground, and whose few houses have uncleanly surroundings,—14 cases occurred. The upper end of Bridge Street borders a basin, whose dangerous condition was described in the report of the State Board of Health for 1874; upon this portion of the street, 15 cases occurred.

Of the 66 cases which are reported from Ward 3, 3 were upon Creek Street, 10 upon High Street, 3 upon Pratt Street. Since these streets are quite short, these 16 cases occurred in pretty close neighborhood to each other. The condition of many of the tenements and their surroundings on these streets will not bear sanitary inspection; especially on High and Pratt streets, where 13 cases occurred, defilement of the surface-soil with slops and garbage is common, and the shallow privies are widely odorous.

The smallest number of cases is reported from Ward 6. This ward includes all of North Salem; its land lies higher, and slopes toward the south-east; the houses are less crowded together. Of the cases reported, 10 occurred upon Upham and Walter streets, 12 upon Mason Street and the short streets, Friend and Beach, which run from its upper end to the banks of the North River, and 4 upon Grove Street. The other seven of the 33 cases were widely scattered over the ward.

The 534 cases which we have thus examined do not include all that have occurred during the past year. Reports have been received from nine physicians which aggregate 572 cases; many cases must have fallen into the hands of other practitioners from whom we have received no statement. The whole number of deaths from diphtheria for the year 1876 was 102. If it be right to approximately estimate the whole number of cases by comparing the figures we have with the reputed practice of the physicians in Salem from whom no report has been received, the number would considerably exceed 900.

The epidemic has been so wide-spread, and the failure to trace many cases to any *contagion* have been so numerous in the experience of our physicians, that we are led to conclude that, like the distemper which afflicted horses in the year 1873, it spreads through

some unknown miasm. Not only the uncleanly sections of the city have been visited, but families whose surroundings seemed unexceptionable have suffered by this disease. Therefore we do not find the *source* of diphtheria in filth and insufficient sewerage; but one cannot help thinking that it has found its *best nidus* in localities and among people whose hygienic conditions were unfavorable. Insufficient nourishment, insufficient clothing, ill-ventilated apartments, tobacco-smoke in small rooms, extremes of temperature in a room which must be used at one and the same time for cooking, washing, dining, and sitting room, wet feet, reeking odors from foul yards, dirty stairways and cellars of old houses, exposure in the use of cold and uncleanly privies, are all calculated to produce irritation of the throat and respiratory organs, and to diminish their powers of resistance to any morbid poison.

Of the contagiousness of diphtheria, when one is directly associated with the disease, we have abundant evidence; but, with so many apparently sporadic cases, it is hard to find evidence that one who has not himself been affected by the disease can bear it to another.

Having alluded to the keeping of swine within the city limits, I will add that this custom, forbidden by our city laws, appears to have been winked at by our city officials. A much smaller number have been kept during the past year, not altogether because of a more strenuous enforcement of the law, but because the people say it does not pay to make pork. The reduction of the number of swine has not proved an unlimited good, since now the people of certain neighborhoods (as in the lower part of Ward 1) find it troublesome to dispose of their swill, so that much more garbage lies scattered about the yards. Our present mayor, General H. K. Oliver, has called the attention of the city government to the expediency of providing for the removal of swill, ashes, and all refuse from the houses, at the expense of the city. This could be so done as to improve our sanitary condition at small expense; since the value of the pork that could be thus raised, and the value of the real estate, created by the filling in of stagnant basins with ashes and the refuse of gardens, would go far toward reducing the expense of collecting the material.

The incompleteness of our system of sewerage is due to the fact that, according to the present law, sewers can be laid only as the owners of estates can unite in requesting them. Hence it not only happens that the indifference, or penuriousness, or possibly pecuniary embarrassment, of a few, may deprive a large section of a much-needed relief; but sometimes the natural and most economical

route cannot be pursued, and an outlet must be sought by a circuitous and expensive course. It is very evident that, with the introduction of Wenham water, so much larger a body of water is distributed over our city by the free use of our water-works, that the old methods of getting rid of sewage are quite insufficient; and, as the city has provided for drenching the city with water, it should also provide, by the most equable plan, for an outlet for the refuse.

An unusual interest in sanitary matters exists among the present members of our city government. The insufferable stench, from which we suffered last summer, aroused people and officials alike. Two mass meetings were held, at which the evils from which we were annoyed were enumerated, and resolutions adopted, requesting our board of health to deal vigorously and effectually with existing nuisances. The board responded by remedying, at once, the most conspicuous evil, by filling up a portion of the mill-pond and covering the flats around the margin of the remainder with gravel. They also gave their attention to devising a method to keep the North River and its banks free from filth. In these and related matters our late mayor, Henry Williams, was active and much interested. His successor, as you know, is an enthusiast in sanitary matters, and has a board of aldermen and common council from whom he is likely to have hearty coöperation. We have hopes, this year, of the appointment of a board of health which shall be independent of the city government, and expect a practical and efficient dealing with the sanitary perils which we have so often recounted.

Your correspondent gratefully acknowledges his indebtedness to those physicians who have furnished him with reports of their cases, and to Mr. Charles H. Hayward for his skilful drawing of the accompanying map (page 447).

DIPHTHERIA IN LOWELL IN 1876.

The year just closed has been a memorable one for Lowell, because in it the city has been visited by the most fatal epidemic ever known in its history, if we add to the 158 reported deaths from diphtheria, 63 deaths from croup, and 10 from diphtheria known to be incorrectly returned under other names, and thus reach an aggregate of 231. The epidemic of typhoid fever in 1846, and of small-pox in 1871, alone can claim a comparison with these figures.

DEATHS.	1846.	1871.*	1876.
Population of Lowell,	29,127	41,000	51,000
Deaths from typhoid fever,	101	—	—
from small-pox,	—	178	—
from diphtheria and croup,	—	—	231
per 1,000 of population,	3.38	4.33	4.50
Percentage of all deaths,	14.64	17.25	20.20

* During this year the mortality from cholera infantum was exceedingly low in comparison with other years.

During the first half of the year, the death-rate was decidedly lower than it had been for eight years, within the same period; but the month of July, with its high temperature and unusual rainfall, rolled up the unprecedented number of 160 deaths, of which 68 were from cholera infantum and 8 from diphtheria.

August, usually the wettest of months, was, this year, the driest; and this circumstance had its effect on the remaining five months, during which the water-supply from the river to the mills was extraordinarily limited. Many of the wells, also, were quite low from time to time. Whether on account of these facts, or in spite of them, the mortality from cholera infantum, which, during the previous two years, was at its maximum in August, was this year greatest in July; and the epidemic of diphtheria, partially re-awakened in July, was now under full headway.

Had it not been for this epidemic of diphtheria, the annual death-rate would have been considerably below the average. There were only 20 deaths from typhoid fever and 5 from scarlet fever. The accompanying chart illustrates some of the facts already stated.

Diphtheria.

In the early part of the year diphtheria was quite strictly confined to the localities in which it had existed during the previous fall. In January the mortality reached the highest point which it had yet attained. From March to July the disease appeared to be almost entirely suspended, but took a fresh start in the latter month, especially on River Street, where it raged for two months. From this time the epidemic began to be more general, and, in the month of August, cases sprang up in the most widely separated parts of the city. The chart, before mentioned, shows some of the relations of diphtheria. The proportion of deaths to recoveries has been stated by several physicians to be 1 to 5 or 6.

Nature of the Disease.—The general character of diphtheria, as it has appeared in Lowell during the past year, is that of a blood poison which manifests itself by constitutional symptoms in excess of the local signs. The latter appear early, in the form of white membranous patches, situated on either or both tonsils and the back part of the mouth, which are, at the same time, sore. The breath is usually fetid. The attack is sudden, the course rapid. Death takes place either by difficulty of breathing, due to the extension of the membrane to the larynx, or by exhaustion ; and recovery is slow on account of the great debility incurred. The after-effects consist mainly of paralysis of various parts of the body. The most common form of paralysis, observed in this epidemic, has been that of the palate. One man, after a severe attack, lost the whiskers on one side of his face.

Age, Sex and Race.—Children under 10 years of age are the most susceptible to infection. In families infected with the disease, adults are very rarely the first to be attacked. The following table gives the mortuary record with respect to ages :—

Under 1 year,	.	.	.	.	.	.	.	.	25 deaths.
1 to 2 years,	.	.	.	.	.	.	.	.	45 "
2 to 5 "	.	.	.	.	.	.	.	.	93 "
5 to 10 "	.	.	.	.	.	.	.	.	47 "
10 to 15 "	.	.	.	.	.	.	.	.	5 "
15 to 20 "	.	.	.	.	.	.	.	.	5 "
20 to 30 "	.	.	.	.	.	.	.	.	1 death.

Out of 303 cases of diphtheria, 144 were males and 159 females.

Of 318 persons affected, 174 were of Irish, 114 of American, 14 of English, 13 of French, 2 of Scotch, and 1 of Swedish parentage.

Locality.—A map representing the elevations of different parts of the city, which are referred to mean low-water mark at Centralville Bridge, or 32 feet below the top of Pawtucket dam, as a standard, shows that the vast majority of deaths have occurred within a range of from 10 to 45 feet above mean low-water mark. There were about 38 deaths within a range of 50 to 74 feet; there were two deaths at heights of 98 and 110 respectively, the first in an improperly-drained region on the slope of a springy hill ; the second in a dry place, with the supposition that the patient contracted the disease in a lower situation just above a swamp. In a certain region 85 feet above low-water mark, on the slope of a ledgy, imperfectly-drained hill, and amidst suspicion of contagion, occurred 2 deaths in one family ; and on another, at a height of 80, was a group of cases in a house whose drainage was exceedingly bad.

The high ground of Centralville, to the east of Bridge Street,

which consists of puddling gravel interspersed with bowlders, the larger part of the fourth ward, including the "Lowell Highlands," and some of the recently annexed territory, the soil of which is partly sandy and partly rocky, and Ayer city, largely high and sandy, were almost wholly untouched by the diphtheritic scourge. Two deaths in the latter district took place in a low swamp.

The only corporations which suffered greatly were the Lawrence, Tremont, Suffolk, and Merrimac, in the first ward; excepting the last three mills, there were only 5 deaths, although there were several mild cases. The imperfectly drained, damp hillside in the sixth ward, sloping down to the Concord; the valley of the Concord, and of the Meadow Brook rivers in the third ward, in which lies the quarter known as the "Flats,"—these all contribute their quota of victims; but the weight of the epidemic fell upon the low-lying district, which, bordering on the river and intersected by canals, comprises, on the city side of the river, the first ward and a part of the fifth. On the Centralville side is the low land, inclusive of River Street, which yielded 8 deaths within a line of 1,000 feet, and is a part of the region, the insanitary conditions of which were pointed out in the last annual report. There were, in the entire district just described, 117 deaths.

Foci of Disease.—The Merrimac Corporation has been more severely scourged by the epidemic than any other part of the city, when we consider the small space infected. There were, in all, 32 cases; there were four deaths and eleven cases in a block of houses on Prince Street, in a very low and damp situation. The vaults in the rear of this block, as well as those in the rear of the block on Colburn Street, are not connected with the sewer. The soil, in this vicinity, was originally a swamp, and has since been filled in, 5 or 6 feet. It consists of rich mould, resting upon sand. In the midst of this region is situated a well, the water from which was used by ten of the families infected. Mr. Pierson, chemist of the Merrimac Print Works, made an examination of this water, the result of which is given (No. 1) in the following table:—

Examination of Water taken from various Wells located in Lowell, Centralville, and Pawtucketville.*

Number.	Date.	LOCALITY.	Alumina.	Alumina and Ammonia.	SOLID RESIDUE.			Chlorine.	Oxygen required to oxidize organic matter.	Nitrates.
					Inorganic.	Organic and Volatile.	Total at 212° Fahrenheit.			
1	1877. Mar. 19,	Well on Prince St., Merrimack Corporation, Lowell.	1.1820	0.0280	42.85	11.43	54.28	7.60	-	Large amount.
2	20,	Well at house on Third St., Centralville.	0.0008	0.2050	†	†	118.53	23.60	-	Large amount.
3	21,	Well at Pawtucketville,	0.0022	0.0035	9.58	9.00	18.58	2.40	0.07	None.
4	24,	Well at Pawtucketville,	0.0015	0.0055	14.28	8.58	22.86	1.80	0.11	None.
5	24,	Well at Pawtucketville,	0.0010	0.0045	28.98	12.52	41.50	11.60	0.06	None.

* Well No. 1 is located on Prince Street, Merrimack Corporation, on the outer edge of the sidewalk. The water furnished by it is largely used by the operatives living in the vicinity. The most important fact learned concerning this well is, that quite a large extent of land occupied by and surrounding it was, about forty years ago, low, wet and boggy; there was also a frog-pond near by; this land was raised about that time nearly six feet, and afterwards the well was dug. The well is about twenty feet deep, lined with brick, and at the bottom is placed a round stone with a hole in the centre.

Well No. 2 is located on Third Street, Centralville, near the bottom of the street, in a yard beside what is commonly called the Mansur House. The well is about fourteen feet deep; no immediate source of contamination presents itself; the water, however, is very foul, for, when any of it is evaporated nearly to dryness, it gives off a very offensive and disgusting odor. The most important fact learned concerning this well was, that up to a certain time, it never failed, either summer or winter, to give an abundant supply of water, but, after a sewer had been built by the city on Third Street, the well very often dries up.

† The determination of organic and volatile matter is of little value in the presence of so much chlorine.

The original sewers of this corporation were built for the purpose of carrying off the sink-water alone ; some of these drains still remain, and are more or less used. They are of small calibre, and are made of stone loosely thrown together without mortar or cement. They are connected with the main sewers, which are of later date and more solidly constructed. The main sewers, which were built for the purpose of emptying the vaults, have calibres varying from 18 to 20 inches, and an average pitch of $\frac{1}{16}$ of an inch to a foot. Each sewer begins at Moody Street, with a blind extremity, and receiving the sewage from the mills at the opposite end, empties into the river through large race-ways, except on Colburn Street, where a connection is first made with the city sewer. The great defects of this system of sewerage consist in a want of sufficient water to carry off the refuse matter, and an absence of traps in the vaults and surface connections ; so that, in dry seasons, such as that alone described, there is a considerable escape of sewer-gas both into houses and passage-ways. The lack of communication between the sink-drains and vaults contributes to this deficiency of fluid. It would be interesting to inquire what influence the size of the race-ways, which are very large in proportion to the gateless mouths of the sewers, have, in certain directions of the wind, on the backing up of gases.

In a certain block on Dummer Street, always considered unhealthy, bounded on one side by a suspicious sewer, and on the other by noisome vaults, there occurred, in September, five cases of virulent dysentery, which destroyed three lives within as many weeks. About the same time there were two deaths from diphtheria on the same spot, and since then three deaths from diphtheria have taken place in the same neighborhood.

In a notoriously filthy intermural space, reeking with sewage, called Maiden Lane, there co-existed, in the summer, a case of malarial fever and a group of children sick with diphtheria, of whom two died.

In a very old and dilapidated house, on Third Street, near the corner of Bridge Street, at a low elevation in Centralville, a house, in the cellar of which water frequently stands, there were three cases of typhoid fever in the fall of 1875, and afterwards three deaths from diphtheria and croup. The sewage and other filth is thrown into the yard, around a well, which speaks for itself in our list of analyses. (No. 2, page 455.)

In other quarters of the city we have gathered interesting facts. In a house situated in high, open, cleanly country, a lad of 17 died of diphtheria in August. The lad's sleeping-room was in the range

of filthy odors which proceeded from a leaky water-closet pipe and from a dry well.

On the bank of the Meadow Brook River, in the lowest part of the region called "the Flats," there is a block of houses where the stench from the vaults and drains is very great. Nearly every family in the house had one or more cases of diphtheria. In one of the families there was a case of typhoid fever beside two cases of diphtheria, one of which was fatal.

Early in May, a certain lad was taken sick with diphtheria in a severe form. The odor from the disease penetrated into the room where the milk, which supplied the nourishment of a neighbor's child, was in the habit of standing several hours every day before use. The child was eight months old and lived in a healthy locality. In two weeks after the lad was taken sick, the babe was attacked with the same disease and died.

In the month of January, an epidemic of diphtheria broke out among some children who attended a school in Pawtucketville. The first child attacked lived in a mucky hollow, in a filthy family. She was taken January 5th, and on the night of the 7th three other children, living in remote, healthy regions, and at opposite points of the compass, sickened; afterwards there were 15 cases of sore throat from the same school within two weeks. Some cases occurred in February, independent of the school. The circumstances of the sickness among the children pointed somewhat to contagion, but the evidence in favor of this view was not sufficiently strong. Water from three of the wells (Nos. 3, 4, and 5, page 455), in this locality, were examined by Mr. Pierson and found to be pure.

The facts which are here brought together form only a part of the evidence which goes to show that in diphtheria, whose ultimate origin is unknown, its manifestations, although often erratic, are reducible to certain laws. Admitting that the cause is external in the individual, which appears reasonable, it seems to me that confirmation of the idea that the atmosphere is a carrier of the poison, is obtained in the fact that we have on record four deaths from diphtheria in infants whose diet consisted exclusively of the mother's milk. Of contagion we have had such striking proofs that our physicians generally have testified their belief in it.

The peculiar susceptibility of children to the disease, as well as its great fatality among them, is also well established.

The favorite haunts of the Lowell epidemic have been low levels in the midst of more or less insanitary surroundings. If it be objected that many low and filthy localities are exempt from the disease, I reply, so also certain microscopic organisms are absent

from many stagnant pools, but the fact still exists that those organisms are generally found in stagnant pools. If it be said, on the other hand, that diphtheria occurs in high and healthy localities, I insist upon the rule, and point to the fact that many plants, whose general habitat is moist and fertile lowlands, are sometimes found on dry highlands.

In conclusion, I submit this report as a step towards wider generalizations than investigations in a single locality render possible.

REPLIES FROM CORRESPONDENTS.

From 213 cities and towns, reports have been received relating chiefly to the occurrence or not of diphtheria during the year, and to the circumstances which have been connected with its appearance. So far as these replies are concerned, the opinions of physicians agree, in the main, that the causes of the disease are in part telluric, or meteorological, and at present unknown, and that it is contagious, infectious, and attended with the greatest mortality and severity where generally insanitary conditions, especially soil-moisture and filth, prevail. Like all other diseases, it is prone to attack persons debilitated from any cause. A certain number of cases, which remain unexplained now, might in the future develop facts which would modify their at present "mysterious" nature.

Diphtheria has apparently left untouched or only slightly affected, in 1876, a large number of towns where it was very rife in 1875. Most of the western part of the State has been comparatively free from it, especially the valleys of the Deerfield, Miller, and Connecticut rivers, which suffered so much previously; the exceptions being Williamstown, Adams, and Holyoke, where the disease was for a time quite severe and fatal; portions of Westhampton, Northfield, Granby, North Amherst, Ware, Warren, Brookfield, and South Hadley Falls, where it was less so, and a few other towns contiguous to some of the above, where there were local epidemics, not severe or very extensive, and sporadic cases.

In the central part of the State, diphtheria was prevalent but not very fatal in Worcester, most of the year; in Fitchburg quite fatal; in Princeton there was a local epidemic of short duration, but severe; Pepperell and Groton and to a less extent Ayer, Lancaster and West Boylston on the

Nashua River, suffered somewhat. In Framingham and a half-dozen of the adjoining towns, the disease was quite prevalent for a few months in the year; North Easton suffered severely throughout the year. In Fall River and in the towns, extending up the river to Taunton and eastward to Fairhaven, there was considerable prevalence of diphtheria in not a very fatal form; the Cape and islands, excepting Plymouth and local epidemics in Yarmouth and Harwich, were very free from it.

From Boston along the north shore of Massachusetts Bay, the disease has been most severe, extending also up the Charles and Mystic rivers to some extent, visiting Waltham with severity; Lynn, Salem and Gloucester suffered the most heavily; but Beverly, Manchester, Swampscott, Saugus and the other towns to a considerable degree. On the Merrimac River, Lowell, with its shallow soil overlying rock, had the greatest prevalence and fatality; in Lawrence and Methuen there was less of the disease, with not considerable fatality; in Haverhill there were comparatively few cases; and in Newburyport it was somewhat prevalent only in November and December.

Diphtheria is described by Hippocrates, is known to have been prevalent near the Cambridge marshes at least as early as the beginning of the present century, and first received a distinct place in death-returns as diphtheria, the name given it by Bretonneau after his careful investigation of the epidemic at Tours, in 1818; he did not consider it contagious. The epidemic in France of 1855, which is thought to have reached England by way of Boulogne, established its contagious character in the opinion of the English sanitarians. During the first half of the present century, it has been returned in English-speaking countries as croup, scarlet fever, ulcerated or putrid sore throat, *angina trachealis*, *cynanche maligna*, etc. In the epidemics of the last three years in Massachusetts, the greatest severity and fatality have been reached in rural districts, corresponding in a general way with the experience of England. In that country, "generally, it is more fatal where there are offensive privies than in towns with water-closets; but cases are found in the year in variable numbers in every county and almost in every district." That diphtheria is not as highly contagious and infectious as scarlet fever

is rendered certain from the fact that, unlike the latter, it does not prevail most in densely-populated places, where the opportunities for contagion and infection are best. That it is like typhoid fever in being more common in country districts, where there are more chances of filth-infection from privies, cesspools, polluted wells, etc., would be a fair reason for classing it among the filth diseases, unless, like yellow fever and intermittent fever, it is intimately connected with emanations from undrained land.

Of course, the causes of disease, or, at least, the conditions under which disease occurs are exceedingly complex and not simple, so that in most cases it is extremely difficult to give its precise or even approximate value to each factor. This will be noticed in the replies of our correspondents, who are quite guarded in assigning sole causes to certain phenomena. While thorough investigation is valuable in settling these questions, and often directs research with scientific precision, it should be remembered that science, as well as ignorance, sometimes has its narrowness, and that false conclusions may as easily be reached by pushing minute examination of a single point, as by general and what is scientifically called careless observation. A striking illustration of this statement may be found in the case of four different recent reports explaining the infantile diarrhoea in an English city, all by different "causes." It may be fairly questioned whether the great attention now given to "filth diseases" and drainage, important as they are, does not often mislead people into overlooking other and potent sources of ill-health.

The replies of the correspondents given below refer to diphtheria, unless it is otherwise stated. The following table shows at a glance the main facts with regard to the prevalence, etc., of diphtheria during the past year, so far as our correspondents are able to report from their own experience and from conversation with others.

The contamination of water used for domestic purposes reported in Kingston (page 482) is well worth noting, considering the great distance of the source.

Dr. Hulbert's report of the epidemic of typhoid fever in South Dennis suggests the danger of living in a filth-laden air.

T O W N S .	Populat'n by Census of 1875.	Prevalence of Diphtheria in 1876.	Conditions under which the disease occurred.
Abington, .	3,241	No cases known, . . .	-
Acton, .	1,708	Few cases in October, . . .	Nothing special.
Acushnet, .	1,059	Epidemic in October, . . .	Soil moisture.
Adams, .	15,760	Prevalent in North Adams, . . .	Varied.
Amesbury, .	5,987	Few cases in Nov. and Dec., . . .	Doubtful.
Amherst, .	3,937	Prevalent in northern part in last half of the year, . . .	Nothing special.
Andover, .	5,097	Few cases in spring, . . .	Houses, etc., well.
Arlington, .	3,906	Few cases, . . .	Good, and bad also.
Ashburnham, .	2,141	Local prevalence in summer, . . .	Damp soil and filth.
Ashby, .	962	No cases known, . . .	-
Ashfield, .	1,190	Very few, if any, cases, . . .	-
Ashland, .	2,211	Few cases throughout the year, . . .	Not especially unfavor- able.
Athol, .	4,134	Very rare, . . .	Good.
Attleborough, .	9,224	Few cases, and very mild, . . .	Not stated.
Ayer, .	1,872	Local epidemic in November and December, . . .	Good and bad.
Barnstable, .	4,302	Very few cases, . . .	Polluted air and well- water.
Barre, .	2,460	Few cases, . . .	Exposure to cold.
Becket, .	1,329	Very few cases in December, . . .	Filth and moisture.
Belchertown, .	2,315	Very few cases, . . .	Damp and filth.
Bellingham, .	1,244	Very few cases, . . .	Good and bad; wet and dry.
Berlin, .	987	No cases known, . . .	-
Berkley, .	781	Few cases, but very fatal, . . .	Doubtful.
Bernardston, .	991	No cases known, . . .	-
Beverly, .	7,263	Prevalent, and in May rife, . . .	Good and bad surround- ings.
Blackstone, .	4,640	Only two cases known, . . .	Nothing special.
Blandford, .	964	No cases known, . . .	-
Bolton, .	987	No cases known, . . .	-
Boston, .	341,919	Quite prevalent, especially in suburban parts, . . .	Under investigation.
Boxborough, .	318	No cases observed, . . .	-
Boylston, .	895	Very few cases, . . .	Wet and dry.
Bradford, .	2,347	No cases known, . . .	-
Brewster, .	1,219	No cases known, . . .	-
Braintree, .	4,156	Very few cases in March, . . .	Not satisfactory.
Bridgewater, .	3,969	Very few cases; none fatal, . . .	Not stated.
Brimfield, .	1,201	Only two cases known,—fatal, . . .	? Polluted well.
Brockton, .	10,578	Severe epidemic beginning just at the close of the year, . . .	Wet soil.
Brookfield, .	2,660	Not many cases, but severe, . . .	More commonly wet soil.
Brookline, .	7,500	Quite prevalent, . . .	Mostly wet soil.
Buckland, .	1,921	Very few mild cases, . . .	Not stated.
Cambridge, .	47,838	Moderately prevalent, . . .	Doubtful and various.
Carlisle, .	548	Moderately prevalent, . . .	Good and bad, wet and dry soil.
Chelsea, .	20,695	Quite prevalent, . . .	Generally bad drainage.
Chester, .	1,396	No cases known, . . .	-
Chicopee, .	10,331	Very few cases, . . .	Not bad generally.
Chilmark, .	508	No cases known, . . .	-
Clinton, .	6,781	Few cases, . . .	Nothing noteworthy.
Conway, .	1,452	No cases known, . . .	-
Dartmouth, .	3,434	Prevalent in one locality in autumn, . . .	Not stated.
Deerfield, .	3,414	Few cases in latter part of year, . . .	Bad, with lack of cloth- ing, etc.
Dennis, .	3,369	No cases known, . . .	-
Douglas, .	2,202	Few mild cases, sporadic, . . .	Various; good and bad.
Dover, .	650	No well-marked cases known, . . .	-

T O W N S .	Populat'n by Census of 1875.	Prevalence of Diphtheria in 1876.	Conditions under which the disease occurred.
Dudley, . . .	2,653	No cases observed, . . .	-
E. Bridgewater, . . .	2,808	Few cases, . . .	Wet cellars and damp soil.
Eastham, . . .	638	Very few cases, . . .	Wet soil.
Easthampton, . . .	3,964	Few cases, . . .	One bad; the rest good.
Easton, . . .	3,898	Severe epidemic, . . .	Nothing noteworthy.
Enfield, . . .	1,065	Few cases, . . .	Generally bad.
Everett, . . .	3,651	Quite prevalent and severe, . . .	Generally moist soil.
Fairhaven, . . .	2,768	Moderately prevalent, . . .	In most cases, bad.
Fall River, . . .	45,340	Prevalent, but mild, through the year, and epidemic in Nov. and Dec., . . .	Generally bad.
Falmouth, . . .	2,211	No cases observed, . . .	-
Fitchburg, . . .	12,289	Quite prevalent, . . .	All parts of city invaded.
Florida, . . .	572	Only one case known, . . .	Not stated.
Foxborough, . . .	3,168	Very few cases, . . .	Not stated.
Framingham, . . .	5,167	Local epidemic in autumn, and somewhat during year, . . .	Mostly wet and ill- drained.
Franklin, . . .	2,983	Local epidemic; not severe, . . .	Not stated.
Gardner, . . .	3,750	Very few cases, . . .	Various; good and bad.
Gay Head, . . .	216	No cases observed, . . .	-
Gloucester, . . .	16,754	Very prevalent and fatal, . . .	The town is old, badly drained, and supplied with well-water.
Granby, . . .	812	Quite prevalent, . . .	Various; good and bad.
G't Barrington, . . .	4,385	No cases known, . . .	-
Groton, . . .	1,908	Quite extensive, . . .	Mostly wet or filthy.
Groveland, . . .	2,084	No cases observed, . . .	-
Hadley, . . .	2,125	Prevalent at the very begin- ning of the year, . . .	Contagion thought to be chief cause.
Halifax, . . .	568	Prevalent, . . .	Mostly soil-moisture.
Hanover, . . .	1,801	Mild local prevalence, . . .	Good and bad.
Hanson, . . .	1,265	Quite prevalent, . . .	Nothing positive.
Harvard, . . .	1,304	No cases known, . . .	-
Haverhill, . . .	14,628	Not extensively prevalent, . . .	Nothing noteworthy.
Harwich, . . .	3,355	Not extensively prevalent, . . .	High ground; contag'n.
Hingham, . . .	4,654	Two mild epidemics, in spring and in Dec., . . .	Generally good.
Hinsdale, . . .	1,571	Scarcely any, . . .	Fair.
Holliston, . . .	3,399	Some cases in December, . . .	Varying; good and bad.
Holyoke, . . .	16,260	Prevalent and fatal last half of year, . . .	Doubtful.
Hopkinton, . . .	-	Prevalent and fatal, . . .	Not stated.
Hudson, . . .	3,493	Few cases, . . .	Nothing noteworthy.
Huntington, . . .	1,095	Few cases, . . .	Dampness and filth.
Hyde Park, . . .	6,316	Severe epidemic, Feb., March and April, . . .	Generally good; not often bad.
Kingston, . . .	1,596	Prevalent, but mild, last half of year, . . .	Nothing peculiar.
Lancaster, . . .	1,957	Few sporadic cases at begin- ning of year, . . .	Not satisfactory as to cleanliness, etc.
Lawrence, . . .	34,907	Mildly prevalent through the year, . . .	Foul air and insufficient nutrition greatest fac- tors.
Lee, . . .	3,900	No cases known, . . .	-
Leicester, . . .	2,770	Few mild, . . .	Exposure to cold.
Lenox, . . .	1,845	No cases known, . . .	-
Leominster, . . .	5,201	Few cases, . . .	Soil moisture and ? filth.
Leverett, . . .	831	Few scattered cases, . . .	Oftener bad.
Lexington, . . .	2,505	Mildly prevalent, . . .	Nothing noteworthy.

T O W N S .	Populat'n by Census of 1875.	Prevalence of Diphtheria in 1876.	Conditions under which the disease occurred.
Leyden, . .	524	No cases known, . . .	- -
Littleton, . .	950	No cases known, . . .	- -
Ludlow, . .	1,222	Very few mild cases, . . .	No facts.
Lunenburg, . .	1,153	Very few cases, . . .	Generally favorable.
Malden, . .	10,843	Moderately prevalent, . . .	Usually bad; wet, etc.
Manchester, . .	1,560	Few cases, . . .	Usually favorable.
Mansfield, . .	2,658	No cases known, . . .	- -
Marblehead, . .	7,677	Somewhat prevalent through the year, . . .	Often in wet soil.
Marlborough, . .	8,424	Prevalent at close of year, . . .	Variable.
Mattapoisett, . .	1,361	No cases known, . . .	- -
Medfield, . .	1,163	Very rare, . . .	Soil moisture.
Medway, . .	4,242	Few mild cases, . . .	- -
Melrose, . .	3,990	No cases known, . . .	- -
Methuen, . .	4,205	Local prevalence, . . .	Nothing noteworthy.
Middleborough, . .	5,023	Mildly prevalent, . . .	Nothing noteworthy.
Middlefield, . .	603	Very rare, . . .	Exposure and bad ven- tilation.
Middleton, . .	1,092	No cases known, . . .	- -
Milford, . .	9,818	Severe in first part of the year, more mild later, . . .	Nothing noteworthy.
Millbury, . .	4,529	Few severe cases in August and September, . . .	Soil moisture and innu- trition.
Monson, . .	3,733	No real cases known, . . .	- -
Montague, . .	3,380	Few mild cases; one fatal, . . .	Nothing noteworthy.
Monterey, . .	703	No cases known, . . .	- -
Nantucket, . .	3,201	One case, . . .	Damp soil.
Natick, . .	7,419	Isolated cases throughout the year, . . .	Varied; generally not bad.
Needham, . .	4,548	No cases observed, . . .	- -
New Bedford, . .	25,876	Few mild cases, . . .	- -
Newburyport, . .	13,323	Prevalent in Nov. and Dec., . . .	Nothing noteworthy.
New Marlboro', . .	2,037	No cases known, . . .	- -
Newton, . .	16,105	Prevalent during the year, . . .	Nothing noteworthy.
Norfolk, . .	920	Local epidemic, . . .	Not stated.
Northampton, . .	11,108	Unusual good health, . . .	- -
North Andover, . .	2,981	Local prevalence latter part of year, . . .	Unfavorable, as a rule.
Northborough, . .	1,398	No well-marked cases, . . .	- -
Northfield, . .	1,641	Local prevalence, not extensive, . . .	Favorable.
North Reading, . .	979	No cases known, . . .	- -
Orleans, . .	1,373	No well-marked cases, . . .	- -
Oxford, . .	2,938	No cases known, . . .	- -
Palmer, . .	4,572	Very few cases, . . .	Chiefly by contagion.
Paxton, . .	608	Few mild cases, . . .	- -
Peabody, . .	8,066	Quite prevalent and fatal, . . .	- -
Pepperell, . .	1,924	Unusually prevalent, . . .	Worst cases in damp places, etc.
Peru, . .	443	Scarcely any cases, . . .	- -
Petersham, . .	1,203	No cases known, . . .	- -
Pittsfield, . .	12,627	Not extensively, . . .	Something wrong in most cases.
Plymouth, . .	6,370	Quite prevalent, . . .	- -
Plympton, . .	755	Prevalent last third of year, . . .	Soil moisture oftenest.
Princeton, . .	1,063	Severe local epidemic, . . .	Nothing noteworthy, ex- cept contagion.
Quincy, . .	9,155	Prevalent, but not excessively so, . . .	- -
Randolph, . .	4,061	Few cases at close of year, . . .	Generally among for- eigners.
Reading, . .	3,186	Few cases; one fatal, . . .	Generally nothing note- worthy.
Rockland, . .	4,203	Local epidemic in last quarter of year, . . .	Dampness of soil.

T O W N S .	Populat'n by Census of 1875.	Prevalence of Diphtheria in 1876.	Condition under which the disease occurred.
Rockport, .	4,490	Very rare,	Chiefly by contagion.
Salisbury, .	4,078	Very rare,	Exposure to dampness and filth.
Saugus, .	2,578	Moderately prevalent, . .	Nothing noteworthy.
Sandwich, .	3,417	Not prevalent,	- -
Sharon, .	1,330	Quite rare,	Good, generally.
Shelburne, .	1,590	Very rare and mild, . . .	- -
Sherborn, .	999	Very rare,	Nothing noteworthy.
Shirley, .	1,352	Scarcely any,	- -
Shrewsbury, .	1,524	Very rare,	Nothing noteworthy.
Shutesbury, .	558	Very few cases,	Nothing noteworthy.
Somerville, .	21,868	Somewhat prevalent, . . .	Nothing remarkable.
Southbridge, .	5,740	Not at all prevalent, . . .	Nothing marked.
South Hadley, .	3,370	Mild epidemic; but severe at South Hadley Falls, . . .	Nothing marked.
Somerset, .	1,940	Prevalent, but not very fatal, .	Nothing noteworthy.
South Abington, .	2,456	Prevalent during the year, .	More among foreigners.
South Scituate, .	1,878	Not very prevalent,	- -
Spencer, .	5,451	Very few cases,	Nothing noteworthy.
Springfield, .	31,053	Few cases,	Generally unfavorable.
Sterling, .	1,569	No cases known,	- -
Stockbridge, .	2,089	No cases known,	- -
Stoneham, .	4,984	Very few cases,	Nothing noteworthy.
Stoughton, .	4,842	Mildly prevalent,	Nothing noteworthy.
Sturbridge, .	2,213	Few mild cases,	Proximity of filth.
Sudbury, .	1,177	No cases known,	- -
Sunderland, .	860	No cases known,	- -
Sutton, .	3,051	No prevalence,	- -
Swampscott, .	2,128	Rather prevalent, and quite fatal,	Nothing marked.
Taunton, .	20,429	Prevalent, but not excessively so,	- -
Tewksbury, .	1,997	Few cases,	- -
Tisbury, .	1,525	No cases known,	- -
Topsfield, .	1,221	Not extensively, but fatal, .	Nothing unusual.
Tyringham, .	517	No cases known,	- -
Upton, .	2,125	Quite prevalent,	Generally filthy.
Uxbridge, .	3,029	Prevalent and severe, . . .	Nothing marked.
Wakefield, .	5,349	No cases observed,	- -
Wales, .	1,020	Very rare,	Imported.
Waltham, .	9,945	Prevalent since June, . . .	Nothing marked.
Walpole, .	2,290	Not prevalent; cases very rare,	Nothing marked.
Ware, .	4,142	Prevalent, especially in sum- mer,	Often wet and filthy.
Warren, .	3,260	Quite prevalent, but not se- vere,	Wet soil.
Watertown, .	5,099	Some cases in early part of year,	Nothing marked.
Webster, .	5,059	Slight local prevalence, . .	Nothing marked.
Westborough, .	5,140	Not prevalent to any extent, .	- -
West Boylston, .	2,902	Quite prevalent and fatal, .	Damp soil.
W. Brookfield, .	1,903	Moderately prevalent, . . .	- -
Westfield, .	8,429	Very little,	Usually good.
Westhampton, .	556	Quite prevalent,	Nothing marked.
West Newbury, .	2,021	Very rare,	- -
W. Springfield, .	3,739	No well-marked cases, . . .	- -
W. Stockbridge, .	1,981	No cases observed,	- -
Weymouth, .	9,819	Prevalent and fatal since July,	Variable.
Williamsburg, .	2,029	Very few cases,	Usually good.
Williamstown, .	3,683	Rife and fatal in December, .	Often bad.
Wilmington, .	879	No cases known,	- -
Winchendon, .	3,762	No cases known,	- -
Winchester, .	3,099	More prevalent than for twelve years,	Nothing marked.
Windsor, .	624	Scarcely any cases,	- -
Winthrop, .	668	Very few cases, and light, .	- -

T O W N S .	Populat'n by Census of 1875.	Prevalence of Diphtheria in 1876.	Condition under which the disease occurred.
Woburn, . .	9,568	Mild cases throughout the year,	- -
Worcester, .	49,265	Prevalent, but not fatal, . . .	Usually, cause obscure.
Worthington, .	818	Very rare,	- -
Wrentham, .	2,395	Several cases,	- -
Yarmouth, .	2,264	Few cases, but severe, . . .	Soil-moisture and filth.

Acushnet.—As far as my knowledge goes, no case occurred until August, when three were taken down, two of whom died. But some two months later, the epidemic again appeared in three new families, widely scattered from each other. It comprised eight cases, varying in age from three years up to about thirty-five—five of them in one family of six persons. After these eight cases occurred, it again disappeared. Of the latter five cases there were no deaths or serious sequelæ, except slight paralysis of some of the pharyngeal nerves in two cases. They were, moreover, severe cases, without exception. These latter cases presented the same general characteristics as the former five spoken of. I could not trace the least history of outside contagion in any of these cases—I mean outside of the families where they originated. The circumstances of the family, or of all of them, rather, are comfortable as to food and clothing. The air surrounding the various houses was, perhaps, a little more damp than the average, and the ground rather low and a little swampy, though not surrounded by hills. Winds from all points of the compass have free sway without interruption from hollows, etc.

Adams.—Diphtheria has prevailed in North Adams during the past year, and for the last four years, but with far less fatality under the same treatment. I think, from observation in a number of surrounding localities, its fatality is greatest on its first appearance, and, whatever may be the cause, it is less operative in proportion to the length of its continuance, and, like many other forms of disease, tends to exhaust itself. The mansion with careful surroundings has been no less exempt than the hovel; the hill and the malarious valley have seemed to share alike in its distribution, and extremes in temperature, or drought and moisture, so far as I have been an observer, have neither increased nor retarded its progress.

Amherst.—With the exception of some cases at North Amherst, I know of but five or six cases. In all of these cases, the hygienic surroundings have been *good*. In North Amherst all of the cases have occurred within the past six months. With regard to hygienic surroundings, there was nothing peculiar. Some cases of greatest severity were in well-regulated, well-to-do families. The cause of the disease, as it has occurred in my practice, could not be traced to any peculiarity of situation or mode of life.

Andover.—Diphtheria proved fatal in two families, in the spring of 1876. In one family, there were four deaths, and in the other, only one. The four deaths occurred in the course of two weeks, and all were of children. The father, who was first taken sick, speedily recovered. The house in which the four deaths took place was situated on a dry, sandy knoll, was not over-

crowded, and had every facility for drainage. I think there was nothing in the location which could have induced the disease. The house in which the single death occurred was also on elevated ground, isolated, and spacious in its internal arrangement. There could have been no fault in the hygienic surroundings of either of these two houses.

Arlington.—In one case, a family lost two or three children. The house was situated in a low place, a stream of water running on two sides of it. These streams of water were running in winter and spring, and in summer they were dried up. In another case, a family lost two children. The house was situated about fifty rods from the last, on the side of a hill, on dry ground, and with good drainage. These were both on a farm highly cultivated, and in the vicinity of hot-beds.

Ashburnham.—Previous to June, 1876, diphtheria has been almost unknown here. During the past summer the disease prevailed in a small portion of this town, four or five families suffering with it—three cases proving fatal. There have been a few other scattered cases—mild. There were two farm-houses in which fatal cases occurred, situated within ten or twelve rods of each other; the barns containing “piggeries”; hen-pens, etc., joined the houses. Sometimes, in the kitchens and living-rooms, there would be a strong odor from out-buildings. In others, the location was such as I would expect to be healthy, naturally. The surrounding fields are well cultivated, those near, immediately surrounding the buildings, being in grass. I will add that most of the cases occurred in old houses, where the well-water may have been slowly becoming impure by impregnation from out-houses, for years.

Ashby.—There has not been a single case of diphtheria in this town during the present year. Whether it is owing to the elevation of the town, securing pure air, or the hygienic surroundings of our homes, which are certainly equal to any town or city of my knowledge, I am unable to say.

Ashland.—Diphtheria can hardly be said to have prevailed in this town as an epidemic, during the year just passed. The cases have been so scattered through the year, that we must regard them sporadic, rather than epidemic. The disease has prevailed in all the surrounding towns to the extent of an epidemic, especially in Hopkinton, where the mortality has been great. In this town, I have treated only seven cases since the first of last January, and, adding the four cases treated by other physicians, shows only eleven cases for the year. In neighboring towns, I have, during the same time, treated fifteen cases. The hygienic surroundings of these houses were not particularly unfavorable. All classes of dwellings and all conditions of persons were about equally represented. The cases were as follows:—

1. A boot manufacturer; surroundings at home very neat, and his shop in a healthy place. Died.
2. A farmer's daughter, aged 24. Farm and all its surroundings neat and in order. Died.
3. A young farmer, aged 25. Surroundings very favorable for health. Recovered.
4. School teacher; female; aged 23. School-rooms all right; home favorable for health. Recovered.
5. A miller, aged 20. Mill damp, but home very neat. Recovered.

6. Clerk in post-office; female; aged 27. Office dry and comfortable, and home the same. Recovered.

7. Girl, aged 10. Cellar damp, sink-drain foul, pool very near house; privy neglected. Recovered.

8. Girl, aged 24. Family very poor, but cleanly; hygienic surroundings fair. Recovered.

9. Girl, aged 9. Family lived in a crowded tenement-house; bad sink-drain; filthy everywhere. Recovered.

10. Boy, aged 11. Hygienic surroundings very favorable for health. Recovered.

11. Female, aged 28; boot stitcher. Diphtheria complicating "slow fever"; surroundings not bad. Recovered.

No two of the above cases were members of the same family, or lived in the same house, or even in the same neighborhood, nor were any two sick at the same time, except the first two on this list (Nos. 1 and 2), who died the same week. No persons caught the disease from any of these patients. These cases all occurred in Ashland. Just over the Ashland line, in Hopkinton, in an Irish family, all their children, five in number, had the disease; the baby, eleven months old, first, then all the rest in quick succession; the oldest, a boy of 11, had it last. All but the baby recovered. The family were not cleanly in every respect.

Attleborough.—But few cases of true diphtheria have occurred in the last year; occasional cases resembling it, coming in groups, present no severe symptoms, and recover promptly. For many successive autumns, prior to the last two, typhoid fever has been extremely rife. The amount was less in 1875, and showed a further diminution in 1876. We are disposed to attribute the decline of typhoid to the introduction of pure water, but wait for a fuller experience and a larger generalization before it is possible to reach an absolute decision. The fact that the section of the town where well-water was the poorest,—now largely supplied by the public works,—shows a large proportionate decline in fever cases, is suggestive testimony.

Ayer.—This is a new town, almost wholly built within the last 25 years, and I know of no well-authenticated cases of diphtheria within its limits until last winter, when there were perhaps ten cases, mostly mild, and no death. About the first of November (there being no cases through the summer), it appeared in a family consisting of the parents and seven children, all of whom had it, and four died; since then, there may have been a dozen cases, mostly isolated, with a few deaths. Your correspondent was the only one who had it from direct communication with the family mentioned—that is, that can be satisfactorily traced. In the house of the family mentioned, the sink-drain flowed over the front yard *west*, keeping it wet a part of the year; a pig-pen and stable, not properly cared for, were in *close* proximity east and south. One or more kerosene oil lamps have been kept burning *all night* for years (six, to my knowledge—yes, and in spite of it), and were *turned low*, for sake of economy, resulting in completely saturating the house; and with an ill-ventilated cellar, this house may be said to have been, as to its surroundings, *bad*. Of the houses where other cases have occurred, there is nothing to mark them, and, as far as I can learn, they are in a good condition hygienically. Some of them are new, and are occupied by some of the best families. Some of them are located in what we call the unhealthy portions of the village, and, with one or two exceptions, are on light, sandy and porous soil.

Barnstable.—In examining the sewerage of the house, after the death of the child from cerebro-spinal meningitis, it was found that the pump was in the L of the house, in a summer kitchen. The sink was the same used for the waste water from the pump, and was directly over the well, into which the slops of every kind were emptied, and were conveyed, or supposed to be conveyed, by a lead-pipe, to a receptacle some distance from the house. This pipe had burst near the well at some indefinite time in the past, and the slops and refuse from the house had formed a seething mass of corruption, nearly a foot thick, over the ground beneath the house—all that could not find its way into the well. I attributed the death of the child to this condition of affairs, in positive and unmistakable terms. The surface of the earth under the house was cleaned and a large quantity of carbolic acid was used; the drain-pipe was mended, and I was assured that everything was in perfect sanitary condition. When diphtheria occurred, in February, I made further inquiries, and found the receptacle for the slops overflowing, *within 20 feet of the well*, the character of the soil being a loose, coarse gravel, permitting free percolation through it. I pronounced the water in the well absolutely poisonous, and that its further use would be culpable. The well was at once disused and a tubular well driven some distance from it, which is now used.

Becket.—These cases were in a very respectable and neat family, but the house is situated within 20 feet of a stream of water which receives the wash of two large tanneries. A privy stands upon the bank of the stream, used by several families, and the debris is carried away only when the water is high.

Bellingham.—In some of the cases (particularly those who had had the disease previously) the hygienic surroundings were good; in some of the others—in quite young children—the surroundings were *fair*, though in the case of one family, the house was situated near swampy land. In the case in South Franklin, spoken of above, while the house stood upon high, though moist land, and far from swamps or bogs, the family were in somewhat close circumstances, and my impression is that the food was not of the best character, and was far from well cooked and prepared, while but little attention was paid to personal cleanliness; neither was the water from the kitchen (the sink-water) well conducted off. The privy was away from the house, and I should hardly think could have had much to with the case.

Berkley.—I do not know but the hygienic surroundings where these cases have occurred are as favorable to health as where the disease has never prevailed. Those three fatal cases before named, were on this wise: No. 1. A boy about ten years old was taken, the location of the disease being almost exclusively in the posterior nares; no passage through the nose could be obtained by any means; the patient died comatose. An infant sister died in twelve hours from the attack; the mother had it mildly. No. 2. A cousin, about the same age, living about one-third of a mile from this place, died in the same way. The other members of the family had it very mildly. Two cousins, adults, came to the funeral of the patient No. 1 from Rehoboth, had the disease afterwards in the same way, and just escaped death. No. 3. A young married lady, living nearly one-third of a mile north of patient No. 1, assisted in the funeral affairs, had the disease in the same way,

and came near dying; none of her family were affected. All of these cases occurred on a little promontory made by the Taunton and Assonet Rivers—the soil rocky and gravelly, mostly, except on the banks of the rivers, where the tide-meadows lie.

Beverly.—Diphtheria has prevailed to a considerable extent, not properly epidemic, but of frequent occurrence. It has occurred in all situations and among all classes with about equal frequency and severity. The causes of the disease are not clear to me, either by reading or observation. It comes where least expected, and does not appear when its supposed causes are most efficient. . . . Diphtheria has been much more prevalent in Beverly during the last year than for any other year in my recollection. The greatest number of cases occurred during the months of April and May, though it has not been entirely absent at any time. The type of the disease during May was very severe, and it was in that month that most of the fatal cases occurred. Since that time, the disease has been of a milder form, and the number of cases much smaller, although we are separated from Salem (where there has been a great number of cases during the fall months) only by an eighth of a mile of water, and with which town we have daily and constant communication. The locations and hygienic surroundings were very various; frequently there were overflowing cesspools and privies in close proximity to the houses; perhaps as frequently there seemed to be no defect in the hygienic surroundings. The most severe, and the fatal cases, so far as I can learn, occurred in poor families, where no attention could be paid to cleanliness, sufficient nourishment, or to proper drainage. In one tenement there were five cases, three in one family and two in another, with three deaths. Investigation showed that both families used water from the same cistern, which water was nauseous to the taste and smell; the cistern was about eight feet from a foul cesspool which had not been emptied for several years, and was on a plane about four feet lower than the cesspool. The cellar floor was wet, especially near one side of the cistern. The cesspool and cistern were cleansed and disinfected, and there were no more cases of diphtheria in the house. The disease has not been confined to one part of the town more than another, and the majority of the cases have occurred among children.

Boston.—The decline in the death-rate of Boston, as shown by the mortality tables for 1876, indicates an unusually favorable condition of the public health. The whole reported number of deaths for the year was 8,252 against 9,033 in 1875. Assuming the population of Boston, in the middle of the year, to have been not far from 346,000,—an estimate somewhat conjectural, but believed to be not wide of the truth,—we have a death-rate of 23.84 to the 1,000 living, against 26.18 in 1875, a decline of 2.34 per 1,000. Excluding the five outlying, recently annexed towns, the mortality rate rises to 24.78 per 1,000, which is a little above the annual average death-rate of Boston for the twenty years previous to the annexation of those towns, although 3.54 less than in the preceding year.*

This diminished mortality, due in no small degree to the constant sanitary supervision of the City Board of Health, may be also attributable to the partial subsidence of epidemic influences, and the unusual mildness of the

* The writer takes this opportunity to correct what he fears may have been a misapprehension on the part of the Registrar of his words in the opening sentence of his last Report on the Health of Boston. He intended no reflection upon that officer.

winter, the mean temperature of the first three months of the year having been five degrees higher than in the corresponding period in 1875.

It will appear from the following table that the highest average weekly mortality was in the third quarter of the year, while the fewest deaths occurred in the second and fourth quarters. The high rate of mortality, in the first quarter, was largely due, as will be seen below, to the prevalence of diseases of the respiratory organs, and the still higher, in the third quarter, to diarrhoeal diseases.

Deaths and Meteorology for 1876.

	Average number of deaths weekly.	Mean temperature, Fahrenheit.	Average daily range of temperature.	Avg. weekly range.	Relative humidity.	Fall of rain, inches.	Prevailing winds.	Number of deaths to 1,000 living.	Deaths in London, per 1,000.
Year, . . .	158.6	-	-	-	-	-	-	-	-
1st Quarter, .	172.7	30.0°	17.4°	42.5°	74.2	13.48	S. W., . . .	26.2	24.7
2d Quarter, .	139.3	55.8°	17.7°	34.9°	68.3	7.81	W. to S. W., .	20.9	20.9
3d Quarter, .	182.6	67.1°	17.3°	30.5°	69.5	10.93	N. W. to S. W.,	27.4	21.5
4th Quarter, .	140.2	37.1°	16.8°	32.5°	71.6	16.35	W.,	21.0	21.4

The diseases to which the excess of mortality was largely due arrange themselves into two groups, one comprising three of the zymotic class, viz., scarlatina, diphtheria and cholera infantum; and the other the acute and chronic forms of pulmonary disease,—especially pneumonia and phthisis. It will be noticed that the death-rate in the second and fourth quarters nearly corresponds with that of London, for the same periods, the excess appearing in the first and third quarters,—the periods of pulmonary and diarrhoeal diseases.

Of the 8 zymotic diseases to which there is always a greater or less liability, there were 2 from which there was an almost entire exemption. But 3 deaths are recorded from small-pox, and but 2 from measles, during the year.

The deaths from scarlatina were 456 against 530, or 5.52 against 5.91 per cent. of the whole mortality in 1875. The yearly average for the previous ten years was 4.48 per cent. It will be seen by the table below that it proved most fatal, as in the preceding fifteen years, in the four winter months, while in England it is said to be most prevalent and most fatal in the last quarter of the year. The lowest mortality was in August and September.

The mortality from diphtheria was even greater than in 1875, when the deaths rose to the nuprecedented number of 418. During the first quarter of the past year, before the epidemic wave had begun to subside, it was more fatal than in the subsequent quarterly periods, the deaths numbering 225. In the third quarter they had declined to 88, again rising in the fourth to 138,—making the whole number for the year 575, or 6.94 per cent. of the entire mortality. The average for the previous ten years was 1.50 per cent.

The deaths from croup were 132 against 214 in 1875. It was most fatal in January and May, and least so in September.

The deaths from whooping-cough were 58 in number, or 0.70 per cent. of

the whole mortality, against 0.44 per cent. in 1875, although less than the average mortality from this disease for the previous ten years.

The diarrhoeal diseases were the cause of 824 deaths. Of these, 544 were from cholera infantum, which, notwithstanding the unusual heat of the summer, was less fatal than in 1875.

The number of deaths constituted 6.59 per cent. of the whole mortality, against 7.94 per cent. in the yearly average for the previous ten years. The rate per 1,000 living was 2.38, a decided decline from the mean of the previous eleven years, which was 3.02.

The deaths from typhoid fever were 144, 81 less than in 1875, and 1.74 per cent. of the whole mortality. The average percentage for the previous ten years was 2.58.

The deaths from phthisis were 1,279, against 1,357 in 1875. The percentage to the whole mortality being 15.37, and the number to the 1,000 living, 3.69, against 3.86 in that year, showing a still further decline in the mortality from this disease.

Table showing the Deaths per 1,000 from Phthisis in Five Census Years.

1850.	1855.	1865.	1870.	1875.	1876.
4.28	4.57	4.22	3.96	3.86	3.69

Pneumonia, also, was less fatal than in the preceding year. The whole number of deaths from this disease was 518 against 666, and 6.27 per cent. of the whole mortality, against 7.43 in 1875. It proved most fatal in March, and least so in September, as appears in the table below.

The deaths from bronchitis were 226, against 259 in the previous year. The largest mortality for this disease was also in March.

The following table gives the monthly mortality from the above diseases, with the deaths under one and five years of age, and of persons over seventy years of age. It does not include still-births, which were 491 in number.

Table of Monthly Mortality.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Percentage of mortality.
Total deaths, . . .	609	709	728	681	587	541	672	855	647	613	540	670	8,252	-
Under 1 year, . . .	157	191	205	142	105	129	364	350	216	119	107	128	2,213	26.80
Under 5 years, . . .	280	305	306	269	196	224	499	495	330	230	187	242	3,563	41.80
Small-pox, . . .	-	-	-	1	-	-	-	-	-	-	1	1	3	0.03
Measles, . . .	-	-	-	1	-	1	-	-	-	-	-	-	2	0.02
Scarlatina, . . .	96	63	47	40	23	24	26	17	19	24	33	53	456	5.52
Diphtheria, . . .	92	77	56	43	41	40	30	33	25	44	37	57	575	6.96
Croup, . . .	23	13	12	13	17	6	4	5	3	12	7	17	132	1.59
Whooping-cough, . . .	3	-	4	3	1	2	4	5	11	6	5	14	58	0.70
Diarrhoeal diseases, . . .	11	4	7	14	5	15	271	296	145	43	6	7	824	9.98
Typhoid fever, . . .	14	8	6	4	7	14	8	17	21	24	13	8	144	1.74
Marasmus, . . .	25	34	35	27	28	30	32	55	35	27	22	25	375	4.53
Phthisis, . . .	120	115	101	121	101	97	107	108	63	118	68	120	1,279	15.50
Pneumonia, . . .	69	58	76	57	52	24	21	15	24	36	31	55	518	6.27
Bronchitis, . . .	22	25	31	27	10	17	12	10	13	18	23	19	226	2.73
Deaths in institutions, . . .	-	60	122	63	73	77	96	91	51	63	64	79	859	10.40
Over 70, . . .	76	54	72	73	57	46	49	48	42	49	59	65	690	8.36

It will be noticed by this table that the highest mortality was in August, during the prevalence of cholera infantum, and the lowest in November, after the decline of the diarrhoeal diseases, and before the advent of winter, when pulmonary affections again became predominant. It will be seen, also, that the deaths of children under 1 were more than 26 per cent., and of children under 5 more than 40 per cent. of the entire mortality. It has been, unfortunately, impossible to ascertain, with any accuracy, the localities* where the above diseases mostly prevailed, but they are believed to be nearly the same as in years past, as the same influences are, in a greater or less degree, still operative in those districts.

In reviewing the general sanitary condition of Boston, there is little to be added to what was contained in the last annual report of this Board. It is believed that some preliminary steps have been taken toward carrying into effect the suggestions of the late commission on sewerage, but have as yet been followed by no very definite result. Notwithstanding the constant and invaluable labors of the City Board of Health in improving the condition of tenement houses in various parts of the city,† and in general sanitary supervision, many of the unhealthful influences still remain as heretofore, and will still continue until some more comprehensive system of sewerage and soil-drainage shall be adopted than now exists.‡

It appears from the last report of the Board of Health there are still "acres upon acres densely crowded with tenement and other dwelling houses, whose cellars and basements are wet throughout the year, and whose yards are seldom dry," a condition directly favoring the development of phthisis, and lessening the power of resistance to all morbid influences. In many parts of the city there are also, it is stated, "areas of unoccupied land, the surface of which is covered with stagnant water most of the year, and are made the receptacles of dead dogs, cats and other filth." "During the summer,"—we quote from the report,—"the water becomes covered with a green slime, and is at times exceedingly offensive."§ All efforts for the removal of this evil have thus far proved ineffectual. More than 1,200 lives succumbed in 1875 to causes believed to be preventable. As each life is of a specific value to the State, the question is a pertinent one, whether on the score of economy as well as humanity, any effort should be spared to check so wanton a waste of life. "The hope of saving any number of lives by hygienic appliances," says a distinguished writer, "is enough to fire the ambition of every good man who believes in human progress."||

A recent writer on this subject has hazarded the opinion, that there is no valid reason why a lower death-rate in Boston should be expected during the next twenty years, whatever may be the measures adopted and carried out for the preservation of the public health. The remarkable results of sanitary effort in London and elsewhere, furnish, perhaps, the best reply to this some-

* It would add much to the value of the weekly mortality reports of the Registrar and the Board of Health, should they be made to comprise not only the ward or district where the death occurs, with the age and sex of the decedent, but the number of deaths at least from zymotic diseases that have occurred in each ward.

† The number of houses ordered to be vacated during the last year by the Board of Health was 148, although the number vacated was but 67. The reasons for such action were stated to be "filth, stagnant water, defective drainage, defective and offensive vaults, and want of repair," etc.

‡ See an able paper on Infant Mortality in the Report of the City Board of Health, by Dr. W. L. Richardson.

§ Fourth Annual Report of the Board of Health of the City of Boston.

|| Dr. Farr.

what sweeping statement, and show what may be accomplished by a vigorous and skilful sanitary administration. In the latter part of the 17th century, in what may be called the dark days of sanitary science, we are told that the deaths in London reached 80 in 1,000. This number had fallen, in the 18th century, to 50 per 1,000, and has since declined to its present rate, less than 24 per 1,000, and is still declining. The results of sanitation in many of the rural towns and districts of England are not less striking. In a late report of the Registrar-General, a list of districts is given in which the death-rate had been reduced, by sanitary means, during the last 30 years, from 4 to 6 per 1,000. Perhaps the most remarkable instance mentioned, is North Witchford, where the average mortality fell from 27, in the years 1841-50, to 21 in 1851-60; to 20 in 1861-70, declining to 17 per 1,000 in the subsequent four years, 1870-74. These results, mostly due to the introduction of pure water and attention to proper sewerage, give pertinence to the remark of Dr. Farr, "that it is as certain that a high mortality can be reduced, by hygienic appliances, down to a certain limit, as it is that human life can be sacrificed." That this limit has here been reached, will not for a moment be assumed. The mortality in the past year, from all diseases, excepting those of the zymotic class, which are believed to be largely due to removable causes, was at the rate of 17.89 per 1,000. This, then, may be fairly considered the limit, however far removed, which it should be the aim to reach, and until a decided advance toward it has been made, the work of the sanitarian must be regarded as incomplete.

The following table gives the reported population and death-rates of 56 cities in different parts of the United States:—

CITIES.	Population.	Death-rate.	CITIES.	Population.	Death-rate.
New York, . . .	1,046,037	27.87	Reading, . . .	40,109	24.68
Philadelphia, . . .	825,000*	22.93	Minneapolis, . . .	40,000	10.77
Brooklyn, . . .	527,830	23.31	Paterson, . . .	40,000	26.65
Chicago, . . .	420,000	20.41	Dayton, . . .	36,000	14.47
Baltimore, . . .	355,000	20.79	Evansville, . . .	36,000	17.33
Boston, . . .	346,000	23.84	Lawrence, . . .	35,000	24.14
San Francisco, . . .	300,000	18.89	Utica, . . .	35,000	15.97
Cincinnati, . . .	280,000	20.39	Quincy, . . .	35,000	21.18
New Orleans, . . .	215,000	29.10	Lynn, . . .	33,000	21.72
Cleveland, . . .	162,000	19.90	Springfield, . . .	30,000	21.05
Washington, . . .	160,000	26.40	Harrisburg, . . .	28,000	17.14
Buffalo, . . .	150,000	14.29	Wheeling, . . .	28,000	21.82
Louisville, . . .	150,000	18.50	Nashville, . . .	27,000	33.55
Pittsburg, . . .	145,000	19.97	Fort Wayne, . . .	27,000	15.44
Detroit, . . .	120,000	15.31	Salem, . . .	26,700	23.26
Milwaukee, . . .	110,000	18.95	Erie, . . .	26,037	13.44
Providence, . . .	103,000	14.64	New Bedford, . . .	26,000	22.92
Albany, . . .	95,000	13.78	Elizabeth, . . .	26,000	16.38
Richmond, . . .	75,000	21.98	Terre Haute, . . .	25,000	7.68
Syracuse, . . .	60,000	13.60	Norfolk, . . .	23,000	21.83
New Haven, . . .	60,000	20.43	Somerville, . . .	22,000	20.18
Charleston, . . .	56,540	35.58	Bridgeport, . . .	22,000	18.59
Worcester, . . .	52,000	21.61	Chelsea, . . .	20,692	20.29
Hartford, . . .	50,000	19.06	Taunton, . . .	20,500	20.39
Toledo, . . .	50,000	14.80	Augusta, . . .	20,000	19.80
Cambridge, . . .	50,000	19.32	Wilmington, . . .	20,000	13.50
Lowell, . . .	50,000	22.91	Norwich, . . .	19,000	23.42
Fall River, . . .	46,000	24.13	Yonkers, . . .	17,500	21.77

* This estimate does not include the strangers in the city during the Centennial Exhibition.

Braintræ.—Most of these cases occurred in families in comfortable circumstances. The families were not particular in regard to their sinks and drains; slops and filth too near their dwellings. As most or all of the cases, whether fatal or otherwise, occurred about the same time, and in various parts of the town, it seemed to be the result of atmospheric conditions.

Brimfield.—There have been but two cases of diphtheria in this town during the last twelve months. These were both children, and both belonged to the same family; both died. The house is an old one, and is situated on a side-hill, with quite a steep grade. Almost at the foot of the hill is situated the well from which all their water for household use is obtained. About one rod above this well, their sink-spout empties all the refuse water and slops directly on the surface of the ground, and, as water will run down hill, it of course runs and stands all around the well.

Brockton.—I think the bulk of the cases of diphtheria reported in our vicinity have been confined to that portion of our town where the soil is springy and new; what might be termed our low lands. The drainage of the houses in this vicinity is everywhere poor, and the sink-water runs on the surface of the ground until it is lost by self-exhaustion. The well-water is poor, as is the case generally in our town, with a few rare exceptions.

Brookline.—The hygienic surroundings of the houses on the marsh, where most of the deaths occurred, are *extremely* poor. They are crowded and filthy. In that locality a sewer which drains two of the principal streets—Washington and Walnut—empties into a very slow-running brook, which is, to all intents and purposes, an open sewer. In summer, the stench is at times intolerable. Eight of the deaths occurred upon a street which runs parallel and very near to this brook.

Buckland.—There has not been a severe case of diphtheria in town the past year; there have been some half-dozen very mild cases. I have been in practice here more than twenty-five years; during this time there has not been a single year when there was not twice the amount of acute disease there has been the past year. All of our fevers have been of the mildest type.

Conway.—We have had no diphtheria in our town during the past year. The epidemic which prevailed here very fatally during the winter of 1874 and 1875 spent itself mostly in the following spring, though an occasional case occurred during the summer and autumn following; but since then nothing of it has appeared.

Dennis.—There are but few places better drained, or in past years that have been more healthy, than South Yarmouth; yet diphtheria has prevailed there for ten or twelve months, to the sorrow of not a few families. The exact number of deaths, or the number of cases, I am unable to state, but what is so curious and wonderful is, that in West Dennis there should not be a case, although separated by only some ten rods of water.

East Bridgewater.—The hygienic surroundings in the cases mentioned were apparently the same as in many other dwellings. A great many of

our people have wet cellars. Quite a large portion of the town has a clay subsoil, and, being level, the drainage is imperfect.

Eastham.—Where the cases referred to took place, was in the lowest lands of Orleans, near salt-marsh on one side and a filled-in swamp on the other side.

Easthampton.—I know of only five cases of diphtheria during the year, though popular report makes many more, it being the habit of some practitioners to call every case of sore throat, even the slightest, by that name. These five cases were severe, but none fatal; one was diphtheritic scarlatina. The hygienic surroundings in every case but one were good and salutary; that one was squalid and filthy, though the house was on a mountain-side, and near no other one. It was impracticable to cleanse or civilize the family, yet the case convalesced as well as others with better surroundings, except being followed by a large abscess in neck.

Easton.—This village (North Easton) has been one of the unfortunate victims of the above *fatal* disease. The first case occurred in January, 1876, and we have not been free from it from that day up to date. The last death from it occurred only last week. During the year 1876 there were 45 deaths in this town from diphtheria, and all but two or three were in this village. All the fatal cases were among our foreign population, or nearly so (deaths occurring only in three American families, I think). In some case all the children in a family would be swept away; in one family, 5; in others, 3; in others, 2; and in others, 1. The fatality did not abate until about July, since which time the majority of the cases, although apparently seeming as violent at the onset, have yielded to treatment. Although very few of our American families have escaped having one or more cases in their midst, they have in nearly every case recovered, which I can only attribute to better ventilation, better nursing, more care in and opportunities for keeping the rest of the family away from the sick, and especially to their sending more promptly for their physician. I have been unable to trace the epidemic to any satisfactory cause. I am satisfied that it is not a "filth disease," for it would strike alike upon the cleanest and filthiest houses; neither did poor drainage seem to attract it any more than the reverse; we all shared alike. Although I know that many, if not all, my medical brothers will disagree with me, I must say that I have seen nothing to convince me that it can be carried in the clothing from one to another. Neither do I believe that by simply going into the house or room where a diphtheritic patient is, that there is much, if any, danger of contracting the disease. I have never seen a case where I thought the disease was contracted in that way, and I have watched this matter closely. Notwithstanding my belief, I have always tried to be on the safe side, and use every means in my power to prevent its spreading; have always taken the other members of the family out of school; have advised every one to keep their children away from houses where the disease was, and to keep away themselves, unless needed as watchers or nurses; have advised them to keep away from the "wakes" and funerals. My opinion is, that when it occurs in a family, all or nearly all the family have it, either in a mild or severe form, for the reason that they have all been subjected to the same surroundings and the same influences. I have found that sending all the other children away from home, as soon as the first case made its appearance, did not, in many cases, save the others from having it, before they returned home, even.

Enfield.—All the cases except two were scantily clothed, not well nourished, and crowded together in sleeping-rooms dark and ill-ventilated.

Everett.—There have been 27 deaths from diphtheria, according to the clerk's record, in this town, since January 1. There have been about 70 cases in all. In the case of S——'s family, the three children all died. I noticed that the cellar bottom was *lower* than the privy-vault; called attention of the owner of the house; cesspools also too near the premises. Some fatal cases, however, occurred in localities high and apparently well drained—among the wealthy class, as among the poor; more fatal during August and September than before.

Fairhaven.—In a great majority of cases that have come under my observation for years, the sink-hole or privy has been so near the well of drinking-water, that I have been forced to the conclusion that here lies the primary source of the disease.

Fall River.—There have been with us throughout the year past occasional cases of diphtheria—which two months ago assumed a proportion entitling it to be called a mild epidemic. This has now subsided. Generally, the hygienic surroundings of houses where cases have occurred, have been bad. I don't recall any case in my own practice where they have been what they ought to be, though there were those in which no neglect was apparent.

Fitchburg.—Diphtheria has been quite prevalent in this city for the past year (1876), bringing up our death-rate per 1,000 from below the average to 20. We have a population, according to the last census, of 12,289. During the eleven months ending December 1, there have been 54 deaths from diphtheria, 21 per cent. of the whole number of deaths, a greater mortality than from any other disease. Usually our greatest mortality is from consumption, averaging about 17 per cent. of all deaths.

In 1875 there were 14 deaths from diphtheria.

In 1874 there were 3 deaths from diphtheria.

In 1873 there were 3 deaths from diphtheria.

The present epidemic began in March, 1875. At this time a young man who had been at work in Greenfield, Mass., was returning in the cars to his home in Bolton, Mass. On the arrival of the train in Fitchburg, he seemed so sick that he was left at the station and taken to the almshouse. He grew rapidly worse and died soon after his arrival there. This disease was diphtheria in an unusually severe and rapidly fatal case. A few days after, a daughter of the keeper of the almshouse was taken sick with diphtheria, and died in a few days. She lived in the same house where the young man died, but had not been in the room with him. The young man's body was taken to his home in Bolton, and soon after the funeral, two of the family were taken sick with, and one died of, diphtheria. I speak of this to show the apparently contagious character of the disease in the young man's case.

This, the first death, occurred March, 1875, in South Fitchburg, a part of the city about one mile distant from the railroad station, and a little separated from the main part of the city. The only cases of diphtheria, and they are not many, which occurred for the next seven months, occurred in this district, mostly a low district near the Nashua River, though the almshouse where the boy died is situated near by in a healthy locality above the valley of the river. During this seven months there were four deaths—six,

reckoning the two at the almshouse already mentioned. One occurred in June, one in July, one in September, and one in October, all of the four in French families. In October, two weeks before the last death above mentioned, the disease appeared in the city proper. The first six cases all attended one of the grammar schools, but no local cause was discovered there, and it soon appeared in all quarters of the city, the first death occurring in October, making two deaths in October in the whole city. In November there were 3 deaths; in December, 5; in January, 1876, 4; in February, none; in March, 13 (the height of the epidemic one year after its first appearance). In April, there were 4 deaths; in May, 5; in June 8; in July, 4; in August, 3; in September, 4; in October, 3; in November, 5.

Of the 14 deaths in 1875, there were:—

Of French parentage,	7	Under 5 years of age,	8
American parentage,	5	Between 5 and 10,	3
Irish parentage,	2	Between 10 and 15,	2
Under 2 years of age,	2	Between 15 and 20,	1

Of the 54 deaths in 1876, up to December 1, there were,—

Of American parentage,	25	Between 5 and 10,	19
Irish parentage,	22	Between 10 and 15,	3
French parentage,	4	Between 15 and 20,	2
English parentage,	3	Youngest, 22 days.	
Under 2 years of age,	11	Oldest, 16 years.	
Under 5 years of age,	28		

The disease has prevailed in all quarters of the city, where city water is used and where it is not, where there are sewers and where there are none, where it is high and where it is low, where it is dry and where it is damp, equally or nearly so among native and foreign population, most extensively in children under ten years of age, and in the month of March. It has seemed to me to be more widely prevalent in localities where the drainage is most imperfect and dampness most common. City water is pretty generally introduced into the city, but we have very few sewers. This makes an increase in the surface-moisture inevitable, and I think may explain why diphtheria has remained here so long and prevailed so extensively. I do not say that the virus of diphtheria was introduced in a concentrated form by the case brought from Greenfield, finding here a place favorable for its development, but I think the facts are very suggestive, and you can draw your own inferences. I may say, as having some bearing on this subject, that typhoid fever has not been quite so prevalent as usual—comparatively little of it. . . .

. . . Diphtheria has been almost constantly prevalent during the past year, and hardly a month has passed without its fatal cases. In two years it has been one of the prevalent diseases much of the time, and I may safely say that more cases of the disease have occurred in this period than in the fifteen years preceding. It has become a common disease, and the mortality has assumed comparatively large proportions. During the past season, other zymotic diseases have been remarkably infrequent, and almost invariably of mild type. All parts of this city and vicinity have been visited by the disease, and no social condition has escaped; but, so far as I am able to form an opinion, hygienic conditions exercise considerable influence. It seems to

me that I have had more cases in damp, shady localities than in situations that were dry and where there was plenty of light and air. The worst cases I have attended have occurred in poor tenements located in wet places, without drainage, and where the diet of the inmates was coarse and poorly prepared. In several of these severe attacks, the water used by the family was drawn from wells. It has been quite noticeable that, although all parts of the city have been more or less affected by the prevalence of the disease, cases have occurred in groups, one locality or neighborhood usually furnishing several.

Foxborough.—There has been no epidemic of diphtheria and no prevalence of the disease during the current year. I recall only two cases during the year. The first (an infant) was thought to have contracted the disease during a visit in another town. No particulars can be obtained as to treatment, etc. The case was not in the care of any regular physician, and the nature of the disease was not recognized until after the death of the child. Soon after this occurred, a lady, who had been much engaged in the care of the child, was attacked with genuine diphtheria, and recovered after passing through the ordinary stages of a severe attack. She had partial paralysis, which persisted for a considerable time.

Framingham.—The locality where most of these cases occurred was wet and badly drained. House-drainage, cesspools, wells, etc., as good as in other part of the town.

Granby.—A. Three cases in one family; two deaths. No evidence of filth as a cause for the disease; no other cause found. B. Eight cases in this family; four deaths. Family, Irish, and have always lived in filth. C. Three cases in another family; three deaths. Mother visited friends sick with the disease in another town, and her own children had the disease soon after her return to it. The family "B" also had the same disease soon after a visit to the house of "C" by the mother. D. Three cases. No evidence of filth as a cause; all recovered. E. Three cases; all recovered; lived near a pond from which the water had lately been lowered; no other cause discovered. F. Two cases; no cause detected; all recovered. Family "B" and family "D" lived on low ground, but in dry places; the other families on high, dry ground. These families lived more than a mile from each other.

Halifax.—I have had about 50 cases in my practice during the present year; only 18 of these cases occurred in this town. Last year there was not a single case. Most of these cases were in dwellings located in low, damp places, many of them having water standing in the cellars. In one family of 11, every member, with the exception of the mother and infant, had the disease in a very malignant form.

Hanover.—Since the epidemic of 1866-7, which was very malignant and fatal in this section, I have seen no case that could properly be called diphtheria until March, 1875; and this epidemic had its origin from the same source as that which proved so severe in South Hanson. Four of my cases died, two of which were just convalescing from scarlatina when attacked: one from the intensity of the poison owing to filthy surroundings; and the fourth very suddenly, probably from paralysis of the heart occurring ten days after treatment was stopped. I have considered the surroundings care-

fully in every case, and, with the exception of the fatal case mentioned above, cannot connect the disease with very objectionable hygienic causes; and this case, though the house was damp, yards very filthy, and water bad, cannot positively be said to owe its malignancy to these causes, as there were five other cases in the same house, which recovered without developing unusual malignancy, though attended with severe local and constitutional phenomena. With the exception of diphtheria and some malignant cases of scarlatina, which occurred last winter and spring, there has been no severe sickness during the year.

Hanson.—Last year it was confined to the southern part of the town along the low lands, and there were very many fatal cases. This year almost all have been in the northern part of the town; the only fatal cases were in South Hanson. There had not been a case in South Hanson for two months when a boy (about 10) was taken sick and died in less than a week. There have been no cases there now for three months.

Haverhill.—Diphtheria has not prevailed to any extent since the last report. We have been wonderfully exempt from the disease as an epidemic. The cases that have occurred have been sporadic, and quite mild in character. Some of the neighboring towns of New Hampshire have been severely afflicted with the disease, and several families visiting those localities from this city have been afflicted with the malady. I can discover nothing in the "surroundings" that would have a tendency to induce the disease. Three cases occurred in a house free from dampness, situated in an elevated region, the family occupying the *upper* tenement. Other cases have occurred under a great variety of local peculiarities, but I do not know of a single case in the more filthy and neglected portion of the city. Our worst cases have been confined to elevated regions, with sunny exposure and sandy soil. Our water-supply is pure and abundant, and our drainage better than the average of rural cities. . . .

During 1876 we had very little of diphtheria in Haverhill, the few cases being mostly in January and December. I have not found any unhealthy condition or circumstances to be common to any great number of houses in which I have seen diphtheria. I am confident that the average sanitary condition of the habitations of my diphtheritic patients is not lower, but rather higher, than the average of all my other cases of illness. As an illustration of this statement, I will state that I saw at least 50 cases of all grades (mostly light) in this epidemic before one of them was in an Irish family, and that in all there have been but very few cases amongst the Irish, although every known sanitary law is hourly violated in the quarter inhabited exclusively by that nationality. Epidemic influence and the facilities for contagion are the only causes for the disease I have been able to trace out satisfactory to myself.

Harwich.—There have been but 12 or 14 cases of diphtheria in town this year; all of which occurred within the months of December, 1876, and January, 1877. The houses where each case occurred were on high ground and in one neighborhood. My opinion is that the latter cases were wholly from contagion, and, in fact, by a careful examination of the surroundings, I find no cause for the first cases. All the cases were children except two, and were of scrofulous diathesis, and inclined to sore-throat—tonsilitis or croup. The origin of the cases is not explained to us satisfactorily, the hygienic surroundings being *good*.

Holliston.—The disease first appeared in a family where the hygienic conditions were *favorable* for the generation of any filth disease; but afterwards cases occurred in families where the hygienic conditions of houses and surroundings were good, and the inmates had not been exposed by contagion, as far as known to myself or patients. The disease *seemed* sporadic rather than epidemic.

Hingham.—Diphtheria has not prevailed here, except sporadically, until within a year. The first case appeared April 28th, in a girl of eight years. Her brother, aged 14, was taken sick five days later. First patient died on the fifteenth day, from asthenia; the boy recovered. Two weeks after death of first patient, an older brother, aged 18, was taken sick, and a sister of 16, four days later. The former died on the ninth day, and the latter recovered after long convalescence, with paralysis. One child escaped the disease. A little girl, playmate of the first patient, was taken down one week after her, and the disease spread through the family. Out of five children four died. At about the same time, the disease appeared at two other remote parts of the town. No new cases appeared after June, until recently. During the last month there have been a few isolated cases. There were in all about 30 cases and 11 deaths, not counting those of recent date. The hygienic surroundings of the house in which the first case appeared were seemingly good. The house stands high and dry, in a retired part of the town. The family are exceptionally neat. Apparently, the hygiene of the other infected houses and their surroundings were generally equally good. The well of the family in which the disease was most fatal has been found by analysis to contain the purest water of ten wells taken from different parts of the town. The disease afflicted rich and poor alike.

Holyoke.—Diphtheria has prevailed here during the past six months to a greater extent than ever before, probably. Neither has it ever before been so fatal. In several instances, nearly the entire families have been blotted out. In one instance, three children and the mother were taken out of a family of six, all in less than a week; in another, two children in about forty-eight hours. It has invaded all parts of the city, but has been most fatal in what, from its topography, was considered a healthy location. But, unfortunately, in that section, the sewers are not yet completed, and the "hygienic surroundings" not what they will be another year. But it has prevailed to as great an extent in the best-drained portions of the city, though not so fatal in degree. It has become a question in my own mind whether the bath-room and water-closet in such close proximity to the sleeping apartments in our modern houses are not a most fruitful source of this loathsome, disgusting disease.

Hudson.—There have not been many cases of diphtheria in this town for the past year. In my own practice I have had only eight, and can learn of only very few others. There have been no fatal cases, and most of them have been of a mild type. It has never prevailed here to any great extent, although we have a large number of cases of throat diseases. The cases have occurred in all parts of the village and the surroundings, so far as we were able to learn, were not different from the majority of families in town. Nearly all of my own were families in comfortable circumstances, and cleanly.

Huntington.—There have been but few cases—not to exceed a dozen, with bad, damp cellars and accumulation of filth near the houses. I think, how-

ever, that the dampness has been more productive of diphtheria than the filth. I have not known a case where due attention had been given to drainage, cleanliness and ventilation.

Hyde Park.—A severer epidemic occurred during February, March and April than has ever before visited our locality. The care of twenty cases fell to my own share. Of these twenty, seven terminated fatally. Five cases occurred in one family, where three died. In another family, some mile and a half distant from the first, three cases occurred, two terminating fatally. In this family, the patient that survived has only just now recovered her former standard of health. In a former paper I have stated that paralysis had not happened to be among the sequelæ that I had seen, but, in this case, complete paraplegia occurred, also paralysis of muscles of speech, with dimness of vision; and all this came on after convalescence from the diphtheritic affection had become apparently well established—so far, that the patient had walked out in the grounds about the house. In still another family death ensued suddenly after diphtheritic symptoms had apparently nearly subsided, death resulting from prostration. The other cases of recovery seem now to suffer no ill-effects. In two or three instances I have not been sure that the drainage has been perfect, and the water-closets were looked after as well as seemed possible, but there was a chance for suspicion of them in perhaps two instances. Nine cases occurred, resulting in four deaths, in three houses out of five standing side by side on the same side of the same street, in a region as perfectly drained as it is possible for it to be; and it must be admitted that every attention was paid to cleanliness, in at least some of these families, that can be paid to it anywhere. One isolated case occurred where the residence was on high ground sloping from it in all directions, and as free from dampness as it is possible for ground to be,—where the family was small and the privy cared for as well as it could be, and one would say that the hygienic conditions were as favorable as anywhere in any community, and yet a fatal result was expected for days, and was finally barely escaped. I cannot draw any inferences concerning the influence of hygienic conditions from a review of my cases. Their severity has certainly not been in direct ratio to the filth and dirt by which they have been surrounded. Very few of the foreign population, so far as I know, have been affected. Of my twenty cases, none were of that class. Why they have been so nearly exempt, I do not know. Why others have not been afflicted, I cannot tell. I have tried to give results as they actually took place.

Kingston.—Diphtheria has never prevailed in this town to any great extent, but there has been more during the past year than all previous years, and mostly the last six months. I have kept no record of cases, but should judge there had been forty or fifty cases the last six months, mostly of a very mild form. I beg to report to you an interesting fact or circumstance which came under my observation a few months ago; viz., Beside a small, never-failing brook is a spring, with a tub or barrel set in the edge of the brook, where two families get their water for drinking and cooking purposes. During the dry weather last summer, a man drove an artesian well, 150 feet from the spring, and on land ten feet higher, using common iron pipe, not galvanized. The well was put down about twenty feet, and the pump was worked by a windmill for irrigating purposes. In a few days after the pumping commenced, the families noticed that the water in the spring was

not as good as usual. It did not taste good, and tea made from it was black and not fit to drink.

Lancaster.—No cases of diphtheria since the past winter, when several occurred in different parts of the town, widely separated and at different elevations. In some instances, drainage (natural) was all that could be desired. Still a diphtheritic tendency has been noticed in most diseases throughout the summer—slight soreness and discoloration of throat, without diphtheritic patches. Most of the cases seen last winter were in Irish families, where there was a decided want of cleanliness, with a great deficiency of ventilation, with filth in the immediate vicinity, and probably, contaminated water. The above, with the epidemic tendency, would be sufficient to develop the disease. Until the past winter, Lancaster has been free from the disease.

Lawrence.—Diphtheria has been mildly prevalent in this city during the greater portion of the past year, although it cannot be said to have risen to the dignity of an epidemic until the month of December. Deaths from this cause are recorded in the city clerk's register for every month in the year excepting January, February, and April. In March, there were 2 deaths; in May and June, 3 each; in July, 1; in August, 2; in September, 7; October, 3; November, 8; and in December, 17; making a total of 46 deaths for the year. The cases which have occurred in the city have been, for the most part, of moderate severity, curable by prompt and skilful medical treatment, aided by efficient nursing. A severe type of the disease seems to have prevailed in the adjoining town of North Andover, south-east of Lawrence. The disease has found its subjects in nearly every portion of this city; in the dwellings of the wealthier, as well as those of the poorer classes, though to a much less extent in the former; but its victims were chiefly among the latter. The record of deaths shows a notable exemption of that portion of our citizens whose hygienic surroundings are of the higher order, and whose dwellings are the abodes of abundance and comfort. Two-thirds of the deaths were among our adopted citizens, or their children. One-half of them occurred in houses and in surroundings whose hygienic condition was a fair average of that which prevails among the lower classes generally. The other half occurred in localities where morbid influences of various shades of bad, undoubtedly had much to do in developing the disease. The same conditions did not obtain in all the cases. In some, bad drainage; in others, close crowding in small rooms badly ventilated; in others, the odors from a contiguous privy, and in still others, damp cellars containing decomposing garbage were the conspicuous causes which rendered the air of the dwellings unwholesome. While undoubtedly a specific contagium hovers in the atmosphere around a locality infected with the disease, exposing all persons who possess a susceptibility to it, fouled air and insufficient nutrition are the two factors which contribute most to make the disease virulent and fatal. I believe the latter to be the direct or indirect cause of more deaths than the former. Personal cleanliness, pure air, warm clothing, and warm houses, with good substantial food, properly cooked, would not, it is true, utterly stamp out the disease, but it would probably deprive it in a great measure of its virulence and reduce its mortality to a very small percentage of its present rate; and this reduced mortality would be still further diminished if those attacked with the disease were promptly placed under good treatment. The propagation of diph-

theria by direct contagion is a fact of frequent observation, of which the recent epidemic in this city and neighborhood has furnished many confirmatory illustrations. On the other hand, the value of prompt isolation of the affected persons, and of the use of disinfectants to deprive the floating germs of their pernicious energy, were strikingly exemplified in a case which occurred in North Andover, where the air seemed to be surcharged with the poison of the disease, and where many cases of a malignant type proved fatal. The cottage, favorably situated, contained a family composed of three adults and five children, the oldest of the children being seven years old, and the youngest but three weeks old, the mother just recovering from her recent confinement. The oldest girl was taken sick with the disease, which proved to be of a putrescent character, and attended by dangerous hemorrhages and extreme prostration. After many days of uncertainty as to the result, convalescence began, and she made a slow and tedious recovery. As soon as the nature of the disease had been discovered, which was not until the physician had been called, who found the symptoms, both local and general, fully manifest, she was removed to another room, her attendants only being allowed access to her. All the rooms of the house which were occupied, were daily thoroughly aired and filled with the fumes of burning sulphur. All the excretions of the patient were removed in close vessels and buried, and the utensils disinfected. As no other member of this family contracted the disease, while in the immediate neighborhood, whole families had been prostrated by it (in one instance, five out of seven stricken children had died within four days), the inference seems to be reasonable that the fortunate exemption of the four small children and three adults was due to the means employed to protect them.

Leominster.—There has been but very little of diphtheria in this town during the past year, though there have been a good many cases of common sore throat, some of them having small patches of exudation upon the fauces. All these cases were benign in their character. I know of but three families where diphtheria (genuine) has appeared during the last year. One family lived in a house standing upon a sandy soil, with good drainage. The family consisted of father and mother, three children, aged 5 years, 2½ years, and 6 months old, servant girl (Irish), and farm boy (Irish). The boy 5 years old was seized first, and died on the fourth day, the disease extending to the larynx and air-passages. The servant girl had the disease severely, but recovered; the farm boy was affected but slightly. The second child and babe escaped. In another family, in a different part of the town, three children, aged 7, 10 and 14 years, had diphtheria. In one of them, the air-passages were affected, but all finally recovered. The house in which this family lived was situated on wet land. I could find no cause of the disease about the premises, except the "soil-moisture." The third family consisted of three persons, husband, wife and daughter. The daughter sickened first and died on the twelfth day. The exudation of lymph extended to the air-passages. The mother, after taking care of her daughter for seven days, was seized with the disease and died after five days' illness, with congestion of the brain, apparently, besides the throat affection. They both died the same day. The mother was 45 years old, the daughter, 16 years. The house was situated very near the putrid stream that carried the refuse from the tannery at the North Village to the Nashua River. You examined it last summer with Prof. Nichols. The brook ran within three or four rods of the house. The husband escaped the disease. Of the eight cases, three were fatal.

- *Malden.*—There have been from 15 to 20 reported deaths from diphtheria during the past year. I have personal knowledge of 4 fatal cases, in which there could be no doubt as to the diagnosis. There have been numerous cases of sore throat of more than ordinary severity, and which were, apparently, influenced by atmospheric conditions, or what is sometimes called an epidemic state of the atmosphere. There has probably been no month during which cases of scarlatina have not occurred. As sore throat is a symptom common to both diphtheria and scarlatina, it becomes difficult to ascribe with certainty, to one disease or the other, the unusual prevalence of inflammatory affections of the pharynx; in other words, scarlatinous and diphtheritic sore throat may be confounded. In some cases, the differential diagnosis is well-nigh impossible. The hygienic surroundings of houses where cases have occurred, have been usually bad. Malden has no system of public sewers. The cesspool is commonly used as a means of disposing of sink and water-closet refuse. Very few cesspools in the town are ventilated properly, if at all, and even the ordinary precaution of trapping is often neglected. Especially is this true among the poor and laboring classes, yet I have traced several cases of severe, and one or two of fatal typhoid, to the escape of sewer-gas into the houses of the "well-to-do," in consequence of combined carelessness and ignorance on the part of householders, which seemed almost criminal. The want of an efficient board of health, with one or more competent physicians as members, is making itself seriously felt here. Many citizens, jealous of their democratic right to poison themselves and their families, if they choose to do so, had rather "take their chances" of disease than have their premises subjected to rigid scrutiny, or which might result in expense to property-owners. Many people don't want to be "ridden by the doctors; what was good enough for their fathers, is good enough for them." The main fact of this nature to which I can refer, is, that the death-rate from filth-diseases is increasing, and the necessity of a good system of public drainage is thus forcing itself, year by year, more strongly upon the attention of all who have any interest in hygienic questions.

Manchester.—In this town diphtheria has occurred oftener among what would be regarded as the better class of people, and only occasionally among people who are most regardless of cleanliness, neatness, good air, drainage, etc. All this is negative, and argues nothing against the rules of health.

Marblehead.—Diphtheria has found its way into the best-located homes in the town, but I am quite sure has prevailed more extensively in low-land and poorly-drained districts. I have noticed a special increase in the number of cases just after a long rain.

Marlborough.—During nine years there has been no appearance of diphtheria coming to my knowledge, in this town, until within the last four weeks. Since then we have had between 20 and 30 cases, most of them light. Hygienic surroundings have been varied, with full as many cases occurring among families where surroundings were *very good*, as in those where they were below the average.

Medfield.—There have been but two cases of true diphtheria in this town during the last year. One case proved fatal; the other recovered after a tedious illness, accompanied with paralysis. The house in which the case proved fatal is badly situated, the ground low and wet, with no drainage

at all, and hardly a chance for any; the other, not so bad, but on the border of low land, almost constantly saturated with water. Each house is rather small, with six or eight children.

Nantucket.—The house where the one case of diphtheria is, is situated on clayey soil, and may be called a damp situation compared with most of the houses here. Very little sickness of any kind has prevailed in Nantucket for a year past.

Natick.—There have been more or less isolated cases throughout the year, not, apparently, confined to any locality, usually in one family only in a given neighborhood. The surroundings have been varied, but not in any case, to my knowledge, bad. The disease has seemed capricious in its attacks, and more influenced by individual exposure to damp and cold than by any endemic bad influences. As to contagion, in one instance it seems proven. In March, the disease was epidemic in Hopkinton. Mrs. L., aged 30, of South Natick, widow, was about to be married; a sister, Mrs. C., came from Hopkinton to assist her in her preparations. The next day after her arrival, Mrs. C. was taken very ill with diphtheria; in six days Mrs. L. was seized, the disease invaded the trachea, and was fatal in seven days. A third sister, Mrs. R., came from Sherborn to help take care of the two first taken. Mrs. R. had a slight sore throat, but did not consider herself ill. She returned home, and two of her children were seized and died; they were not under my care. No other cases occurred in South Natick at that time, nor in Sherborn. The surroundings of both houses were good.

New Bedford.—Diphtheria has not prevailed in this city to any extent during the past year, a few mild cases recovering easily. A few cases of death from diphtheria have been reported in the newspapers, but, as these are based on hearsay or undertakers' reports only, they are to be received with caution.

Newburyport.—Our city has been exempt from diphtheria during the past year until within the past six weeks. During the months of November and December, we have had more cases than during the whole of the past six years. The cases have occurred without any regard to the hygienic surroundings. Some of the most fatal cases have occurred in what we consider the most healthy locations. One of the most severe cases (a young married lady, mother of one child) occurred in a house that has been built only eighteen months. The location of the house is good, and the surroundings are considered healthy; no other case occurred in the family. In one instance, in an Irish family, three children died within ten days, but there was no defect in drainage or water-supply to account for the fatality. My experience in the treatment of the disease has led me to believe that when the membrane extends into the larynx, the case will prove fatal; and when it is confined to the arch and soft palate, the patient will recover.

North Andover.—Diphtheria has been prevalent in one section of our town for three months past. The cases that have come under my immediate observation have been mostly of the better class, with comfortable surroundings, and have been of a mild type, with few fatal cases; it has seemed to me to spread by contagion. In one instance, where a whole family of five children died in one week, the children were poorly fed and poorly clothed;

all slept in one room, if not in one bed; and the water in the well was so low that it was *drained* three times a day to get water sufficient for cooking purposes. It has often been the case, however, where there have been several cases in one family with the same surroundings, that there would be one case of great severity, while all the others were mild.

Northfield.—Our first cases of diphtheria were at South Vernon, in December, 1875. This place is a railroad junction, with a small population, situated partly in Vermont and partly in Massachusetts. It is not an unhealthy place; it is located in the Connecticut River Valley, at the base of quite a hill facing east, about three-quarters of a mile from the river. No stagnant water. The first case occurred at the hotel, and it was thought by some that improper drainage was the cause. Others thought the child took it from a boarder who sickened at the hotel, but went home (to Greenfield, Massachusetts), and had a mild form of the disease. At the same time was a case in another house, about 10 rods from the hotel, both proving fatal in from two to four days. There was a party at the hotel four days before the boy at the hotel died. The other child above mentioned was at the party, together with the family of a brother of the landlord. A few days after, a servant girl at the hotel sickened and died at her home just across the street; also her brother, a railroad employé, died of the same disease. The brother of the landlord, living some three-quarters of a mile south in a healthy location, lost four children, falling a victim himself to the disease. An Irish family living near this family (not noted for sanitary regulations) suffered nothing from the disease. We had 9 deaths—8 in Massachusetts, 1 in Vermont: 6 males, 3 females; 3 adults—2 males, 1 female; 6 children—4 males, 2 females. The disease next appeared six miles south, on the opposite side of the river, the last of January, 1876. We lost 2 cases, both males,—1 adult and 1 child. Next appearance, one mile east of the village. February, lost 3—2 males, 1 female; 1 adult, 1 child, and 1 infant two weeks old. It then appeared in the village in March. We lost here 5 cases, all children,—4 males, 1 female. One fatal case in May; child, male. In July we lost 4 cases, all children, and males, making 24 fatal cases—19 males, 5 females; 5 adults—4 males, 1 female; 19 children—15 males, 4 females. We have had numerous cases of a mild form, all recovering. Some were troubled with the paralysis often attending this disease. I know of no cases now but that have recovered fully. The hygienic surroundings of nearly every house where diphtheria prevailed was as good as could be asked for.

Pepperell.—Diphtheria has been unusually prevalent in this town during the past year. In a population of about 2,000, there have been probably more than 50 cases, varying in intensity from the mild to the most malignant type. In several cases, death occurred as early as the fifth day after the invasion of the disease. Cases occurring in elevated situations, with healthy surroundings and in tidy families, have been more amenable to treatment, and recoveries have almost invariably followed; while in low localities, in crowded rooms, without regard to cleanliness, deaths have been frequent.

Pittsfield.—Diphtheria has not prevailed extensively: 14 deaths during the year 1876. Of these, all but one occurred prior to May 1, and that one in November, viz.:—

In January, 2	Aged 10 years, 1
February, 5	7 years, 3
March, 3	5 years, 2
April, 3	4 years, 1
November, 1	3 years, 2
	2 years, 3
	1 year, 2
	<hr/>
14	14

There was something wrong in the hygienic surroundings, in most cases. 1. Two fatal cases occurred in a house on the margin of a swamp. A woman nursing these carried the disease to her own children, without having it herself; one of them died. 2. Three cases which recovered were in a house with a bad open drain close in the rear. 3. Several cases in a neighborhood where were several privies in a bad condition. 4. One fatal case in a very dirty house. Water was from a well in back yard. 5. One fatal case in a very healthy location, and house connected with a sewer, but the child's sleeping-room was exposed to sewer-gas from a water-closet and from the overflow pipe to tank, which was in a closet opening from the room.

Plympton.—Diphtheria has been very prevalent here for the last four months. I have had 18 cases and 5 deaths. The ages of those who have lived were from 30 years to 2 years. The ages of those who have died were from 7 years to 11 months. Of those who died, all except one died with symptoms of membranous croup. One little girl of 11 months died in 24 hours after seizure, with symptoms of malignant scarlatina; consciousness seemed to have been lost from the commencement of the attack. In the family to which she belonged five were sick with the disease, of whom two died. The little girl that died was the last one who had the disease. Diphtheria has become a very alarming disease. This family lived on high and dry land; they had been exposed to the disease from a person who came to the house, who had had it, but had partially recovered. All the other cases were situated in damp localities. So far as my observation extends, damp and wet locations are the most favorable to it.

Princeton.—There have been 28 distinct cases of diphtheria in Princeton since January 1, 1876. Twenty-three of these occurred after the 15th of August; 6 deaths took place, all after this date. There has been an unusual number of severe cases. The *fatal* ones were of the worst form, and such as I have seldom seen since 1861. With one exception, they were all in one neighborhood. The ages were 2, 3, 7, 8, 9, 11 years. Twelve cases, occurring in *four* families, and including all the fatal cases, with one exception, were in the south part of Princeton, on high land, one-half a mile or more from Quinapoxet Pond. The exceptional case was a little girl who had been ten days in the infected neighborhood after the first cases took place, and then went four miles away and had the disease and died. No. 1. Farm-house; first cases, three in number, and one fatal. The general appearance about the premises not quite right, but not as bad as is frequently met with. There was an offensive puddle under the sink-spout on the west side of kitchen. There had been a stagnant pool in the barn-yard near the house. The well was in the cellar, and the water had been low and poor. No. 2. Near to No. 1; children playmates of those at the other house; disease appeared about

the same time; 3 cases, and one fatal. The water drank was mostly from melted ice. I could find nothing objectionable about the house. The barn-yard, on the west side of house, had been pretty wet for part of the season, but they had carted in loam to absorb it; hogs were kept under the barn. No. 3. Near to other two; 2 severe cases, and one fatal. The well was in the cellar, and water low and poor. The sink-pipe passed into a wooden trough which went through the cellar-wall immediately over the well, so that when it flushed over, the sink-slops would go into the well; the rocks about the well, at the time of examination, were wet with sink-water. There was an offensive hog-pen and privy in the shed adjoining the kitchen. About 40 hogs and pigs had their headquarters at the barn, and ran at large in the fields. Cellar of house dry. No. 4. One-fourth of a mile from the former, but in the same neighborhood; 4 cases, and 2 fatal. The house was occupied during the month of March by a company of ice-cutters, who laid straw upon the floors for beds. When they left the premises, they left the straw upon the floors, and decaying vegetables in the cellar. The present occupant moved into the house in April, and found the premises quite offensive; he removed the straw and decaying vegetables and cleansed the house. He never used the well, but covered it up tight, thinking that it was not good, and fearing that the children might fall into it; it was in the L, about 15 feet from the privy. Water was used from a spring. Sink-slops were thrown out of the back door and left there an unpleasant smell. I do not call any case diphtheria which has not the characteristic coating in the throat.

Randolph.—Almost every very sick patient of diphtheria, and all fatal cases, have been in families where the parents were of foreign birth. Those people seldom, if ever, keep the surroundings of their homes in as healthy condition as the American born.

Reading.—There have been about a dozen cases of diphtheria in Reading in 1876, one of which was fatal. There has been nothing suspicious discovered in the surroundings of the dwellings where these cases occurred, with one exception. In one house in which two cases occurred this year (1876), both of which recovered, and in which, four years ago, three cases occurred, two of which were fatal, the privy was in the basement nearly over which were the apartments occupied by the family.

Rockland.—Within the last three months diphtheria has appeared in one locality of the main village of this town. During these three months it has occurred in some five families, in four contiguous houses, and in another a quarter of a mile distant, to which it was carried by a young girl, who took it from her cousin living in one of the aforesaid houses. There have been ~~some~~ 12 to 14 cases in all, with only one death so far, though two are still feeble. The locality is damp, hygienic surroundings not being good, though in these cases, contagion, to my mind, has been the efficient agent of its spread and prevalence thus far.

Rockport.—Although in the neighboring city of Gloucester diphtheria has prevailed to such an extent as to produce 101 deaths, we have been almost entirely exempt from it. I can call to mind only one severe case in my practice, which terminated favorably. I can therefore afford you but little information on the subject.

Salisbury.—I have seen but one case during the past year, and do not know another in this town. An open drain from the sink-spout terminating in a cesspool, a few feet from the back door, and around which the child was in the habit of playing, seemed to account for the case, which was one of unusual malignancy; there being no other children in the family, or near by, the disease did not spread.

Saugus.—Diphtheria has prevailed here to a moderate extent. The main points to be noticed in the locality are: 1st. In the larger number of cases I was enabled to trace the disease to contagion, and not to local causes. 2d. In some families, in spite of all precautions, all the children exposed were attacked in a severe form, showing a predisposition; others, where no precautions were taken, escaped the disease. (This applies to cleanly houses and well-to-do families.) 3d. The most noticeable fact is that the part of the town around the factories, where the children are the most numerous and exposed to all the vicissitudes of weather, where tenements are crowded and external surroundings not overclean, has been entirely exempt.

Sherborn.—There have been but two cases (in April, 1876), both in one family, one case being that of a little girl of less than four years, which terminated fatally; she was decidedly strumous before, and has always been so. The other case was her brother, about 12 or 13 years of age; it was less severe, and he recovered. A brief statement of connecting circumstances may be of interest. Less than a month before the date of sickness of the first child (the girl), her aunt, who resided in Hopkinton (where diphtheria prevailed extensively), came to South Natick to visit a sister. She had hardly arrived there when symptoms of diphtheria commenced to appear. She was very sick, and barely escaped death. In less than a week after her arrival, the sister whom she came to visit was attacked violently with the disease and died in about a week more. The mother of the above children (another sister) nursed the sister who died, during the chief part of her sickness. On her return home, having a "sore throat," but with no diphtheritic appearances, although using many precautions against possible infection, she slept with the little girl the first night. In five days symptoms appeared in the child.

Shrewsbury.—This family (in Boylston) are average livers, in a house which I have always reckoned badly placed, by reason of a low, wet meadow near by. In this house I have seen two daughters die with pulmonary consumption, and a third was saved, as I believe, by sending her away. At the same time of this case, I was informed that in another part of Boylston there were three or four mild cases of diphtheria in one family.

Somerville.—Nothing especially remarkable can be alleged of those localities where diphtheria has really been present. Some have been in houses where the basements have been objectionably damp, other cases have had the most desirable surroundings. I have had no peculiar experience the past year worth reporting.

Springfield.—We have had but little true diphtheria. So far as I can ascertain, the surroundings in all cases have been such as would make us expect some one of the filth-diseases.

Stoneham.—I am not aware of any marked difference in the hygienic surroundings of the families in which these cases occurred. In none of them could they be called very good, but not worse than those of many houses in which there were no cases of diphtheria. This town suffers much, in my opinion, from the almost total absence of suitable drains, and no effort has been made of late years to introduce a water-supply. While Melrose, Malden, Woburn, Winchester, Medford, and other towns have secured an ample supply of water, we are still dependent on wells and cisterns.

Sturbridge.—The diphtheric cases have occurred, all of them, I think, at the tenement-houses belonging to the corporation. These houses, all or nearly all of them, have privies attached to them, with no sewers or outlets to the vaults, from which the filth is seldom removed, and the stench during the hot weather is intolerable. I sincerely hope measures may be adopted to correct the evil and to prevent a future outbreak of disease, which otherwise will certainly occur at no distant day.

Upton.—There has been more than a usual amount of diphtheria during the past year. If I should go back eighteen months and consider the diphtheria that has occurred during that time, it would probably amount to more than what had occurred here during the ten years previous to 1875. There have probably been about thirty cases during the eighteen months above mentioned, mostly severe cases. The worst cases have generally been those with bad hygienic surroundings—sink emptying at the back door on top of the ground, privy near at hand, and a well in close contiguity to one or both the others. Want of proper care and nursing have been prominent features of some of the cases.

Uxbridge.—I cannot give the percentage, but am sure that it has been more severe and of more frequent occurrence during the past year than during the previous year, and I think it has been the most frequent during the fall months. I have not been able to trace the cases seen to any special unfavorable hygienic influence. In one family of seven, consisting of grandmother, father, mother and four children, a farmer's family with the usual farmer's surroundings, the grandmother, father and three younger children all suffered, three severely; I could not find anything in or about the premises that I could consider the cause. I have felt that where the patient's breath was offensive, the contagion was more to be feared than where it was not offensive. The most severe series of cases in one family that I have ever had, occurred some years since in a family that had been living quite short or poorly, with very little meat. The first, a boy twelve years old, after cleaning out a damp cellar in early spring, barefooted and too thinly clothed, was soon after attacked, the disease apparently spreading to other children by contagion.

Wales.—I have had but one case, that being imported from West Warren, Mass. The child was visiting in this town, and, no doubt, contracted the disease before coming here, as it has prevailed to a considerable extent at West Warren, and was at the time prevalent in her neighborhood. In this case there were three other children in the family, all of whom had been in direct contact with the patient, one or more having slept with her up to the day of her death, and none of them were at all affected by it. The hygienic sur-

roundings of the town are such as to invite disease, one case of malarial typhoid having proved fatal, directly from the effects of a recently flowed and at the time half-emptied pond, directly opposite the house. These surroundings are only atoned for by our high altitude and the fresh winds that sweep across the country. I am constantly surprised at the scarcity of typhoid, considering the positive attractions held out to it, and think it must come sooner or later if the conditions are not improved.

Waltham.—Diphtheria has prevailed in Waltham since June last to a considerable extent, there being more or less cases almost constantly under observation. It has been more prevalent and fatal than at any other time for the past six years. I have treated at least forty and, perhaps, sixty undoubted cases during the past six months, but I have no means, without special inquiry, of ascertaining how many have occurred in town, but I judge from 120 to 150. The hygienic surrounding of the houses in which my cases have occurred have been apparently as good as those of other houses where the disease has not appeared, and probably one-half the cases have been the result of direct and ascertained exposure to infection. The dirtiest parts of our town have had the fewest cases, and I have not been able, in any single instance, to find insanitary conditions sufficient, in my judgment, to account for the production of the disease.

Ware.—There have cases occurred in families where the surroundings were all that could be desired, but such are the exceptions. In a number of cases the surroundings have been exceptionally filthy, with the greatest lack of cleanliness in the houses. Quite a number of the *fatal* cases have been in the overcrowded tenement houses, and in which there is a total disregard of dirt, outside and inside of the buildings.

Warren.—There has been more diphtheria in our town during the past year than in the twenty years preceding combined; indeed, until this last summer, I have not known of a severe case, unless some case of membranous croup has passed unrecognized. There have been from twelve to fifteen deaths and from fifty to sixty cases. The first severe cases occurred at West Warren, in a new brick tenement block occupied by several families. There were two or three deaths in the first family; they moved away. No new cases occurred until another family moved into the tenement vacated, when the disease soon made its appearance in this family, with several deaths. I could not trace the disease to the drinking-water; there was water in the cellar to the house, and the family was large, both with young children. From this the disease made its appearance in several families in this village, generally among the foreign population. At this time there had been no cases in Warren; viz., during the summer. In October the disease made its appearance in a boarding-house in Warren. Two young men, fifteen and nineteen years old, died, one sick only three days, one seven days. This house was on crowded, low ground. There were several other cases in the house, which recovered. From this point the disease made its appearance several times. In some instances the disease could be accounted for by contagion from this house; others seemed to occur without evidence of contagion. In my own practice I have had two cases of paralysis following upon the disease, both coming on from four to six weeks after convalescence, and first affecting the muscles of the tongue and pharynx and then those of respiration, ending in both instances in death.

Watertown.—The disease in question existed (prevailed is too strong a term) to some extent in Watertown during the first four months of the present year. I have not seen a single case since the first of last May. I think I saw, during the early part of 1876, 20 cases of diphtheria, the subjects being children of different ages, from infancy to puberty. Adults enjoyed, so far as I know, a complete exemption. The mortality may be put down at 20 per cent. After January 1, 1876, the disease, as I saw it, was found among people of better class than in 1875, and in locations that were high and free from qualities to which any sanitarian could object. Even in elevated localities the disease proved fatal. A careful observation of cases showed that the constitutional intensity of the morbid process stands in no constant relation to the extent and thickness of the pseudo-membraneous deposit in and about the fauces; for death occurred in one case (the second fatal one in the family) in which the visible amount of trouble in the pharynx was very much less than was noticed in two other cases of moderate severity in a neighboring house, which recovered. It has not been my experience to see this disease in places that were hygienically very bad.

Webster.—I do not think "hygienic surroundings" have had any marked influence over the few cases of diphtheria in this vicinity. There has been no epidemic of the disease, and the cases which have occurred have been in every condition of life.

West Boylston.—Most of the cases occurred in low ground, in a factory village, with no means of drainage; all the houses with a filthy privy next to an eating-room—pig-pens, of course, to make the surroundings more complete. Nasty foreigners, with one of the selectmen as owner. Talk does no good; nothing but a stringent law will ever make things better in this place.

Weymouth.—In my last report I stated, I think, that we had not for months had any genuine diphtheria. Since July of the present year, it has been very prevalent, and in many cases it has proved fatal; sometimes attacking a single member of a family, sometimes affecting every one. I am unable to state the exact number of cases, but it has been quite large. In some cases, the surroundings have been quite faulty. In some I have not been able to trace the disease to any fault in this direction. In one family, where there were four well-marked and very severe cases, and two more slight ones, the location was high and dry, the house large and airy, the drainage excellent, the cellar dry and sweet—the well became dry during the summer, and the family obtained their supply from a neighboring well afterwards; but no cases occurred in the family constantly using water from this last-mentioned source. Did it originate from the *low water* in their own well? I have no doubt that outside influences help to induce the disease; but the more I study its course, as it has appeared among us, the more I am convinced that the physical condition of an individual, either from hereditary or acquired influences, is a very important, and perhaps the most important, element in producing this disease.

Williamstown.—At date, February 24, I have no knowledge of a single case of diphtheria in town; but during the last autumn and the months of December and January, 1876, it prevailed here and in the adjoining town of Pownal, Vermont, with fearful malignancy. I have not been able to ascer-

tain the precise number of cases which have occurred here, but think that about 75 have been under treatment by the resident physicians. Of this number (75), 25, or 33½ per cent., have died. Of the treatment I have little to say. The physicians here are presumably "up" in the literature of the disease, and made use of such remedies and appliances as experience has sanctioned, but without avail. The medical attendant often suffered the mortification of seeing his patient die without being able to delay the event with medicines or skill. . . . Of its contagiousness there is no shadow of doubt, and if there is a relationship between it and scarlatina, as some suppose, then the inference is indubitable that it may be conveyed by *fomites*. I think it can be so conveyed. In most country towns there are no sewers; all the refuse of the house is received in open drains or thrown upon the ground. This town is no exception to the rule. Where the disease first made its appearance, the soil was sandy, filled with quartz boulders, and dry. The families were of the poorer class, temperate, industrious, and moderately clean. In one house, or rather shanty, where two deaths occurred, every conceivable hygienic condition was wanting. Two cases, both fatal, took place near the top of the Taconic Mountain, the rock of which is talcose slate, and the soil slaty gravel; hygienic condition of one house good, the other bad. The lady of one house went and "laid out" the child which had died at the other, took the disease, and died after a few hours' illness. Three houses in which ten cases of diphtheria occurred, nine of which were fatal, were located in a narrow, wet valley or ravine within a short distance of each other, and the families held unrestricted intercourse (hygienic conditions bad); but the families living in proximity, who adopted non-intercourse, escaped entirely. Three cases, all fatal, happened at the Mansion House—a large and new hotel, situated on the highest point in Main Street, carefully drained, and, so far as known, the hygienic surroundings are good. Members of the family had daily intercourse with diphtheritic patients.

Winchendon.—While we have had no cases of the disease in this town, 41 cases have come under my knowledge or observation during the last two years, resulting in 18 deaths. All these cases can be traced to three primary cases. In one instance, 21 cases resulted from one primary, and 11 cases in another instance, and 9 in another. The origin of two primary cases occurred in houses in a *very bad* hygienic condition. One case from which 9 resulted was evidently contracted while riding in the cars. So far as my experience with this disease is concerned, it has been due to contagion or infection.

Winchester.—Diphtheria has prevailed more than at any time during the previous 12 years of my practice here, and I have been constantly on my guard against calling "tonsillitis" diphtheria. I lost 4 cases in March and April out of 14 cases; and 1 case in December out of 5 cases. All the deaths were of children under 4 years old, and 4 were of children under 2 years. In all these the air-passages were invaded. So far as I am informed, not more than 25 cases (including mild ones) have occurred here during the year. In every instance I made investigation, and failed to discover any insanitary conditions of consequence. Two deaths in Irish family of 5; all affected. One death in Irish family of 6; 3 affected. One death in American family of 3; all affected. One death in American family of 7; one affected.

Woburn.—Occasional cases of diphtheria have been quite constant during the past year; *i. e.*, I have seen cases in my own practice during every month

of the past year, excepting July and August. As a rule the disease has been mild, but few of the whole number having resulted fatally—five deaths during the year 1876 having been reported or returned to the town clerk. The rich and the poor, the filthy and the cleanly, have been affected by this disease. Evidences of contagion have been apparent during the past winter. I am of the opinion that, despite all the precautions used by the board of health in isolating families in which scarlatina exists, that this disease is propagated to a very great extent through the schools. In a majority of instances, where this disease has invaded a household, it began with some member of the family attending school.

Worcester.—It has prevailed to a much larger extent during the last than any previous years. There has been an unusual number of severe sore-throats, with and without exudation, with decided constitutional symptoms. The profession are not agreed in calling these cases diphtheria, some claiming that all cases of throat disease with exudation are diphtheria. Unfortunately we had no board of health or health officer to investigate diseases. As to the percentage of fatal cases, I have no means of knowing. I saw one family of five children—all died. The five cases which died were in a basement tenement, with drunken parents—the worst possible hygienic condition. I have seen perhaps 12 cases in my own practice,—all of them in families well-to-do,—modern houses with modern improvements. In one, the best to all external appearance, I found two waste-pipes had become obstructed, and they were suffering from the effects of sewer-gas. The pipes were immediately repaired, not another case occurring in the house. My cases have all recovered. In every instance I have tried to find out the cause, but have failed except in the one mentioned. In all the families there were several children, but in no instance did a second case occur.

Yarmouthport. Those occurring in February and March were exposed to bad surface-drainage, that is, the soil is sandy; but when frozen, as at that time, the water did not flow off readily, so that on warm days there would be a damp atmosphere surrounding the dwellings. The two cases in October were surrounded by filth, the slops being thrown out at the door, so that at times during the summer there was a stench arising.

The following interesting communication from Dr. C. L. Hulbert of South Dennis, is very suggestive with reference to the communicability of typhoid fever in country towns. The wells are certainly open to suspicion, being so near the surface, and so easily affected by a common cause; namely, the rise and fall of the water on the cranberry meadows. The slowly progressive advance of the disease from house to house, too, suggests the fact of gradual pollution of all the wells. Dr. Hulbert, however, thinks that is not possible, on account of the great care taken in disposal of the various kinds of refuse from the houses. The direction of the watershed is southerly, too, whereas the disease progressed northward. About thirty or forty per cent. of the persons living

on the easterly side of the meadow had the disease, four houses only of the fifteen escaping entirely. The people from the westerly side of the cranberry meadow, who watched with the sick, drank water from the same wells which the latter used, and were apparently exposed to the same sources of disease, except that they spent a comparatively short time in the filth-laden air, and did not sleep in it. Moreover, typhoid fever occurred in a severe form in house No. 10, in 1876, without spreading,—the air having been then pure,—a fact which, of course, does not necessarily prove anything. At this time, it is perhaps impossible to do more than our correspondent proposes, in suggesting whether the most reasonable explanation of the epidemic does not lie in the facts as he has stated them.

“ I herewith send you a statement of an epidemic of typhoid fever, as it appeared in my practice during the summer and autumn of 1874.

“ It occurred in a small village of about 26 dwelling-houses, situated in the southern part of this town, lying on the seashore. The village is isolated and nearly surrounded by woods, except by the sea on the south ; in length, from east to west, it is about half a mile, and about a quarter in width. In the centre, and nearly dividing it, is a cranberry meadow of about 17 acres. Originally this meadow was a cedar swamp, cleared, ditched, sanded, and set to cranberries about 12 years ago. Since that time it has been annually flooded during the spring until about the first of June, then let off for the summer, no water remaining on the meadow or but little in the ditches. (See map on following page.)

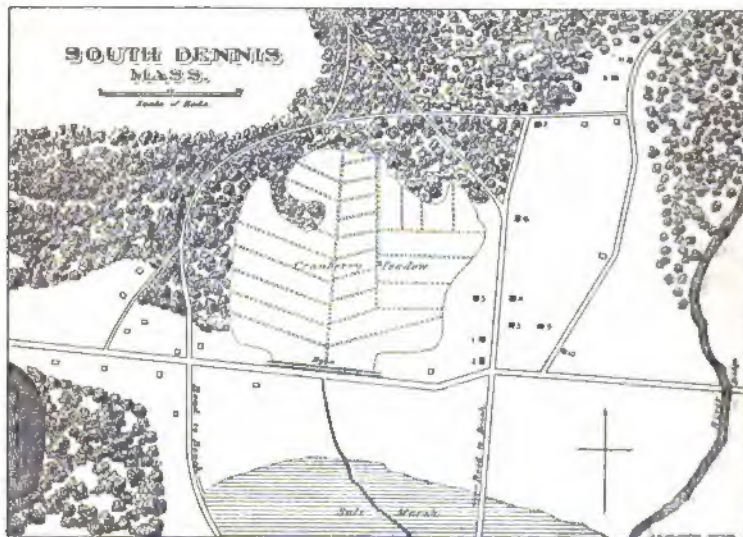
“ During the spring of 1874 the meadow was flooded deeper than ever before, and, when the water was let off, it was thought best to let it off by degrees, slowly ; the ditches were left half-filled, and they remained so until near the last of June. The last of the month was hot and dry. While the ditches were filled with water, they became alive with tadpoles and other like living creatures. By July 8 or 10 the ditches became dry, and all the tadpoles and the like died, and consequently for some days—at least until past the middle of July—there was observed a peculiar disagreeable odor or stench arising from the meadow. The wind at this season of the year is nearly always westerly, or south-westerly, which brought all the vapor and stench from the meadow into or onto the eastern portion of the village. The land in this vicinity is composed of coarse sand ; there is no pan or clay subsoil ; from surface to any depth all

the same. All the inhabitants are supplied with water from wells. The land is level, the wells varying but a few feet in depth, and being from 10 to 15 feet deep.

"When the meadow is flooded nearly all the wells are affected both on the east and west sides of the meadow.

"The inhabitants are as a rule tidy and clean about their dwellings. Good care is taken with slop-holes, privies, etc.

"On July 9 I was called to see W. W. G., age 19, seaman; had arrived that day from Boston by railroad; taken sick ten days before at sea on his passage from Philadelphia to Boston. I found him with all the symptoms of typhoid fever in a mild form; attended him for about 20 days; he convalesced slowly.



"In the same house (No. 1 on diagram) July 20 and 28 and August 25, two sisters and brother of W. W. G. were taken with and had the fever.

"House No. 2, August 5 and 20, two taken.

"House No. 3, from August 9 to September 4, six taken.

"House No. 4, one taken August 25.

"House No. 5, two taken August 26.

"House No. 6, one taken August 20.

"House No. 7, two taken about September 1.

"House No. 8, October 3, all the family, five, taken about the same time.

"House No. 9, one taken September 28.

"House No. 10, one taken September 5.

